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THE NEW PATENT LAW.

AFTER many repeated attempts, made by different governments and by Members of Parliament for some years past, to amend the law relating to Letters Patents for Invention, a new Patent Law has at length become a *fait accompli*, as, although the Act does not come into operation until January 1st, 1884, yet for all practical purposes we may refer to it as if it were already in force.

The Act is intended to supersede a number of former statutes, notably the Patent Law Amendment Act, 1852, but notwithstanding all that has been spoken and written against the latter, few conversant with the subject can peruse the new Act without being convinced of the superiority of the old system, with all its defects, over that which is to take its place at the end of the present year.

The alterations effected have resulted—as indeed is proverbially the case when any piece of workmanship is exposed to the manipulations of a variety of persons with conflicting views and opinions—in unsettling everything and settling nothing, so that few individuals, except it may be some belonging to the manufacturing interests, look upon the measure with anything but disfavour. Patentees discover that, notwithstanding the specious advantages which the Act holds out to them, they were in a much better position under the old *regime*. Patent agents recognise in some of its provisions an evident desire, on the part of the ruling powers, to ignore them and their services to patentees, except so far as they can be utilised in making up for the shortcomings of the Government Patent officials, whilst capitalists or the larger class of manufacturers alone, from mistaken notions of political economy, see with evident pleasure, or fancy they see, in obstructions which will be placed in the way of a poor inventor, an aggrandisement of their own interests.

We shall not stop to inquire how far the community generally are likely to be benefitted by a short-sighted policy, as we have already expressed our views on that subject in our previous articles, published at the time when the Bill was under consideration. We apprehend, however—and from this reflection we derive some little consolation—that the changes which have been made will prove to be of only an ephemeral character. The Patent Law Amendment Act, 1852, has continued in force upwards of thirty years, but he would be a bold man indeed who should predicate a duration of a sixth part of that period for the present ill-conceived and ill-digested measure. Indeed, our own firm conviction is that it will prove absolutely unworkable in practice, and that amendments will be imperatively called for within a very brief space of time to prevent the machinery of the Patent Office from coming to a state of perfect quiescence.

In justification of this expression of opinion, we shall proceed to consider the provisions and probable operation of the new law. A tabular summary of its more important features was published in the number of this journal for September 22nd, and therefore it will not be necessary to enter here into minute details with which its readers may be supposed to be familiar. Nor shall we again go over the whole of the ground traversed by our previous articles published at the time when the Bill was before the House of Commons, but taking the Act as it is, we shall endeavour to lay before the readers of this journal its main provisions, with their probable effect, without prejudice and without partiality.

In considering, however, an Act which (including the portions relating to designs and trade marks) comprises 117 sections, the most difficult point is to determine where to commence. We will, however, begin with what, doubtless, will be considered one of its most important features by inventors and patentees—viz., the provisions for the reduction of Government fees.

The fees are then to be reduced to £4 for a patent of four years, the declaration bearing a £1 stamp, and the complete specification a £3 stamp. The stamped petition *proper* and "notice to proceed" certificate and the stamps for the warrant and patent are abolished. The aggregate amount of the further fees for the maintenance of the patent to fourteen years remains the same as at present, but the £50 duty is not payable until before the expiration of the fourth year, nor the £100 duty until before the expiration of the eighth year. In lieu, however, of paying the duty in lump sums at the end of the fourth and eighth years respectively, the duties may be paid by four annual instalments of £10, two of £15, and four of £20, and as this mode of payment is so much to the advantage of the patentee, it is to be presumed that few persons will elect to pay it by two heavy instalments, as at present. The provisions as to the payment of duties are applicable to existing patents, with the exception that the £100 duty, if paid in a lump sum, must be paid before the expiration of the *seventh* year, whilst the £50 duty may be deferred to the fourth year. It would appear, however, in either case, that if the patentee has paid the £50 in a lump sum he cannot pay the remainder by small instalments.

Again, the forms necessary for preparing the declaration and specifications are to be kept on sale at the various post-offices, and business may be transacted with the Government Patent Office through the post. Inventors may thus purchase their own patent forms, fill them up, and themselves forward the documents to the Patent Office without any intermedium, presuming, of course, that they have had the title of their invention and their draft specification first settled by a competent patent agent.

Further, there would appear to be little advantage under the new system in lodging a provisional specification, as it is evident that, in order to pass, it will require to contain nearly as full and detailed a description as the complete specification. In ordinary circumstances, therefore, inventors may as well file their complete specification at the outset, and thus save the expense of preparing and settling the provisional specification.

It is evident, therefore, that the first cost of a patent will be reduced to a minimum by reason of this triple source of economy, viz., (1) the reduction of fees; (2) the dispensing with the services of a patent agent, except in the matter of settling the specifications; and (3) omission of the provisional specification.

Thus much for the diminution in the first cost of the patent, which doubtless will be highly gratifying to patentees. Unfortunately, however, we have to place some countervailing disadvantages in the opposite scale.

First. Our remarks as to the saving in the cost of protecting an invention have been based on the assumption that there is no opposition to the grant. Unhappily, however, the facilities for opposing patents are largely increased under the Act, as the complete specification being thrown open to inspection before the patent is sealed, interested persons will now be able to get up a case against an application with the benefit of a full knowledge of the contents of the specification. The danger to poor inventors when the invention is valuable and the possession of a patent would be calculated to injuriously affect a trade monopoly in the hands of large capitalists is too obvious to need insisting upon. Indeed, it is not too much to affirm that few inventions likely to prove of commercial importance will escape the ordeal of opposition—a condition of things which opens up a poor prospect to would-be patentees of limited means.

Second. Each patent is to be granted for one invention only, but it may contain more than one claim. This is ostensibly the present practice, but there is good reason to believe that under the new *regime* a more narrow definition of what constitutes a single invention will be advisedly adopted and rigorously enforced. For, be it remembered, that each application is to be submitted to an examining body, which will in all probability take the American system as a guide, and require each substantially different modification to be covered by a separate patent. If we are right in our conjecture, the patentee will gain little advantage by the reduction of fees, as he will find in many cases the aggregate first cost of protecting all the modifications of his invention greater than the first cost of a patent under the old system, although the law officers under their existing powers have repeatedly endeavoured to assimilate to the United States practice in their rulings as to what constitutes a single invention.

Third. There is the examination itself, to which each application is to be submitted. Now, we have always consistently advocated the necessity for subjecting all applications to a thorough investigation at the hands of competent examiners, who should determine as to the novelty and patentability generally of each alleged invention. The examination, however, provided for in the Act is next to useless; indeed, we have no hesitation in saying that one of two alternatives will have to be speedily adopted, viz., either the examination sections must be altogether repealed, or a complete system of examination, such as we have recommended, will have to be instituted. It would be far better for the inventive public that the Patent Office should secretly investigate the novelty of inventions forming the subject of applications for patents than that the complete specification should be prematurely thrown open to inspection, so as to enable all the world to contest the novelty of its contents before the patent is allowed.

(*To be continued.*)

THE BRITISH ASSOCIATION MEETING AT SOUTHPORT.

(*From our Special Reporter.*)

(*Continued from p.* 257.)

MECHANICAL SCIENCE.

Monday, September 24th.

FIRE RISKS OF ELECTRIC LIGHTING.

By Mr. KILLINGWORTH HEDGES, C.E., M.S.T.E. & E.

There is a great difference between the electric currents which have been in constant use for telegraphic purposes and those which are to be supplied by the undertakers under the Electric Lighting Act. The latter can only be said to be free from danger when the heat generated by the current is utilised in its right place, and not developed in the conductors or wires which lead the electricity to the incandescent lamps.

The Fire Risk Committee have already issued rules for guidance of users of electric light. These can hardly be said to embrace all the salient points of the new subject, which can only be arrived at after years of practical work. The necessity of proper regulations has already been recognised by the insurance offices, both in the United States and Germany, and some of their special rules are given in this paper.

The conductors must be properly proportioned for the current they have to carry; whatever resistance there is in the conductor will cause a corresponding development of heat, which will vary with the amount of electricity passing, and inversely as the sectional area.

The material must be free from impurity, otherwise an impure section will increase the resistance. The extraordinary difference in the conducting power of a sample of "commercial" Rio Tinto copper wire, as compared with the pure metal, was shown in an experiment by Dr. Matthiessen—the conducting power being only 13·6, as against 99·95 for pure copper.

The continued heating of an impure metallic conductor has a certain effect on its electrical resistance. With the sample just mentioned, the conducting power at 100° C. decreased from 13·58 to 13·558 after the wire had been heated for three days. It does not always follow that there will be a decrease in the conducting power, as with alloys the opposite effect is produced. A copper-silver alloy showed an increase of ·264 after having been heated to 100° C. for three days, and a tin-copper an increase of ·13.

As the temperature in Dr. Matthiessen's experiments was not increased ever 100° C., the author has made some further experiments—heating the wires by the electric current from a secondary battery to within a few degrees of their melting-point.

The following materials were tried—the wires and foils having such sectional area, and so arranged that, on the current being increased by 20 per cent., they were immediately fused.

The total length of each experiment was 24 hours, during which time the current passing through varied slightly, and the following is a mean of the results:—

Material.	Resistance before Heating.	Resistance of Leads.	Difference after 24 hours.
	Ohms.	Ohms.	
No. 1. Commercial tin wire ...	·815	·8	— ·003
„ 2. Lead, soft	·835	·8	— ·005
„ 3. Copper, soft	·81	·8	No change
„ 4. Pure tinfoil	·86	·8	No change
„ 5. Tin and lead alloy ...	·87	·8	— ·160
„ 6. Albo alloy, in foil ...	·835	·8	No change
„ 7. Alumin. and tin alloy ...	·82	·8	+ ·0008

The resistances were in all cases taken at the temperature of the air, which averaged 69 deg.

The sign — shows that the metal decreased in resistance, and + that it increased after continued heating. Nos. 1 and 3, tin and copper, were found to scale when heated.

A change has been noticed where high tension currents have been sent through a pure copper wire for some time—the wire in the armature of a Siemens machine which came under the notice of the author appeared to be brittle, and gave a fracture unlike pure copper.

The necessity of good electrical connections is very great, also special arrangements of switches and contact breakers, which, when left in unskilled hands, are liable to cause dangerous heating or an arc.

Short circuit is the danger which may be caused by badly arranged wires; most likely a conflagration will ensue without the remedy suggested by the Fire Risk Committee and the Board of Trade is adopted—of having a cut-out or fusible plug in the circuit which gives way when the current is in excess. These should be arranged to melt if the current is more than 10 or 15 per cent. of the working strength, otherwise absolute safety is not arrived at. Ordinary lead or tin wire cannot be used except for very small currents, as on fusing the metal is scattered in a globular form, when it is liable to cause fire. The plan adopted by the author is to take pieces of foil arranged like the leaves of a book; the thinness of the foil causes it to be almost volatilised when melted. The material found to be the most reliable is a special alloy of aluminium, termed albo metal, which is extremely tough, and can be worked much nearer to its fusing point than tin or lead.

The safety of an electric light installation is only insured by testing, which should be done by a current of higher electromotive force than it is intended to use.

When the work has been properly supervised no trouble should be experienced, and the electric light may be said to be much safer than gas, as it is free from those accidents which are due to a servant's carelessness, or by leakage of the pipes. Whatever danger there is with electric lighting is entirely localised to the generating station, where the dynamos and engines would be under constant supervision.

SECONDARY BATTERIES AND THE ECONOMICAL GENERATION OF STEAM FOR ELECTRICAL PURPOSES.

By Mr. C. H. W. BIGGS, F.C.S., and Mr. W. W. BEAUMONT, C.E.

It is not our intention to enter minutely into the theory of storage batteries, but rather to rapidly glance at the practical difficulties which have been met with in the attempts to develop the use of this apparatus. The popular mind holds to the idea that storage batteries have long been perfect, and wonders why they have not been far more extensively used. We hold that one of the first steps towards success is to know the causes of failure. Having found a cause, we can then try to find a remedy. Some of the causes which operated against the immediate and extensive use of storage batteries are known, and various remedies have been and are being tried. A very brief reference to the principal batteries in use will enable us better to describe their faults. Without going back to older experiments, let us take the Planté form as a starting point. This consisted of lead plates opposed to each other forming the positive and negative plates of the cell, and rendered excessively porous by a long continued succession of charging and discharging, the charging current being at first often reversed. After charging, one plate was found to be covered to a greater or less depth with peroxide of lead, the other being pure lead, or perhaps hydrogenised lead. Upon connecting the peroxidised plate by an external circuit with the opposite plate, the peroxide was reduced, and the reduction accompanied by the phenomenon of a current of electricity. In order to obviate

the time and energy lost in rendering the plates porous, M. Faure adopted the plan of coating lead plates with minium. This was found to give very favourable results, and the theory of this form of battery has been treated by Sir W. Thomson and Dr. Gladstone at previous meetings of the British Association. When, however, attempts were made to use this battery upon a practical scale, certain faults were discovered, which led to modifications in the construction. The most recent type is that known as the Sellon-Volckmar-Faure battery. In this a plate of lead is cast somewhat in the shape of a gridiron, thus:—The holes in the plate are filled with minium flush to the surface. The plate has then to be formed, a comparatively simple and inexpensive process when compared with the Planté formation. Still, so far as we know, these various modifications have not led far towards perfection. It is found (1), and this is perhaps the greatest difficulty to be overcome, that under the action of the charging current and after the action, if the plates remain in the electrolyte, the plates bulge or buckle, and this buckling frequently is so great as to cause the plates to touch. Then we have a "short circuit," and those plates or cells containing the short circuit are not only useless, but are to be avoided at all hazard.

Besides the buckling tendency, we have to guard against the loosening of the plugs of minium. Under the action of the current the formation of peroxide goes on, and expansion takes place. Upon the reduction of the peroxide there is the contraction. Now, even if the containing lead plate or grid was not acted upon we should get a gradual loosening of the plugs, but the lead itself is acted upon, and the bad effect is hastened. The result is that the plugs drop out, or, if they do not drop out, are loose, and the conductive continuity of the plate as a whole is weakened. One great aim in the construction of accumulators is to have the internal resistance as small as possible, therefore anything that increases this resistance is to be avoided.

Thus the electro-chemical effects which have hitherto prevented the extended use of secondary batteries in electric lighting may be classified under two headings, viz.:—

1. Those relating to the cathode or reducing pole in charging; and
2. Those relating to the anode or oxidising pole in charging.

The shortcomings to be referred to in the former category are, perhaps, a more serious detriment than any other, since they interfere *ab initio* with the due working of the cells, whereas the other shortcomings lead merely to a certain loss of the electrical energy accumulated, and to the ultimate destruction of the anode pole within a period of time which is inconveniently limited. It will be recognised and admitted by all who have had practical experience in the construction and working of secondary batteries that the initial difficulties in obtaining a really efficient reducing pole have been far greater than those in connection with an oxidising pole initially efficient and gradually augmenting in efficiency until the final breakdown of the elements by the disintegration of the entire mass.

Cathode (Charging).

The difficulties in connection with the cathode element would appear in the usual forms of these batteries to have been almost entirely due to the use of a plate of lead in establishing contact with the active material, viz.—sulphate of lead to be reduced in the operation of charging. In the first place, sulphate of lead is reduced only with great difficulty and slowness by means of a lead cathode, especially when the electrolyte contains no constituent capable of holding in solution a portion of lead sulphate. Moreover, with an electrolyte of dilute sulphuric acid, lead and hydrogen are in such close proximity in the electro-chemical scale that a tendency exists to the electrolysis of the hydrogen compound (H_2SO_4) rather than to the electrolysis and reduction of the lead compound (sulphate of lead). The same tendency to the evolution of hydrogen, which, in the case of lead supports, frequently results in an almost entire separation between the surface of these supports and the "active material," which should properly be in close contact with such surfaces, is no longer observed when a material, such as "carbon," strongly electro-negative to lead and hydrogen, is employed in obtaining contact with the active material, nor have we very far to seek for the cause of this difference. It appears clearly to be traced to a "local action," which is active in the case of carbon.

If we suppose some portions of a carbon surface to be in close contact with lead sulphate, and other portions to be in direct contact with the fluid electrolyte, we may admit that the tendency to the evolution of hydrogen by the electrolysis of the hydrogen compound would be active mainly at the latter surfaces. Any hydrogen, however, separated by electrolysis would not be immediately evolved from the carbon surface, but would become "occluded" within the mass, rendering the surface in question powerfully electro-positive to carbon in its normal condition. Local currents would therefore be produced due to the contact with each other and with an electrolyte of two conductors, which would be at a considerable distance from each other on the electro-chemical scale, and the effect of such local currents would be to bring about the recombination of the hydrogen liberated, and also a reduction of lead sulphate upon those portions of the carbon surface in close contact with the lead salt. In the case of the lead support no such local action could occur to any appreciable extent, by reason of the extreme weakness of the local currents which would be produced by the contact with each other, and with an electrolyte of lead "electroplated" with hydrogen and lead in its normal condition. In the plates with the ordinary lead support to the active material, hydrogen is probably evolved as gas from the lead surface, and it will not be surprising that such evolution more or less completely breaks the connection between the support of metallic lead and the active material or layer of lead sulphate, which should be in the closest contact with it. Here, then, is another cause of weakness in a battery wherein the supporting material is lead, and we have every reason to believe that the use of carbon, as introduced by Messrs. FitzGerald and Jones, will prove an effective remedy. At least, the results of experiments carried out during the past two years, both on a small and on a large scale, have been very satisfactory. But there are other reasons why lead supports are unsatisfactory; for instance, the surface of contact with the active material appears altogether insufficient when it is compared with the surface of contact obtained by saturating carbon fragments with lead sulphate, and, preferably, filling up the interstices with similar active material. The objection that the lead supporting plate is liable during the running down of the secondary couple to become more or less completely coated with a coherent film of lead sulphate, which film, in the subsequent operation of charging, becomes detached by the action of the hydrogen liberated (initially in very minute quantities) at the surface of the metal, is, of course, entirely inapplicable in the case of the carbon surface. If the considerations advanced are correct, the substitution of carbon for lead as the conductor or support for obtaining contact with the active material at the cathode or reducing pole is a very important improvement in the construction of secondary batteries. It must be mentioned that any similar use of carbon at the anode or oxidising pole is not only detrimental, but absolutely destructive to the efficiency of the secondary couple based upon the electro-chemical reaction between metallic lead and the peroxide of the metal. It does not appear to be generally known, even amongst those who should know better, and therefore we hardly expect it to be known by the thousand and one dabblers in applied electricity who appeal so continuously to the Patent Office, that it is impossible to produce a layer of lead peroxide in contact with carbon, and *à fortiori* in contact with any more oxidisable material, such as copper. Thus, those who have from time to time suggested the use of carbon in secondary batteries, have implicitly or explicitly assumed or intimated that this material is applicable equally to the cathode and to the anode. Experiments upon a large scale, giving results absolutely negative from a practical point of view, have completely demonstrated the fallacy of such an assumption.

A question will probably present itself to many minds, and may, perhaps, be at once answered. It might with some reason be supposed that a carbon surface, coated with reduced lead, would be electro-negative to a lead surface coated with the same material, and if this were the case the fact would certainly constitute a drawback to the use of carbon, for we cannot afford to sacrifice even a small percentage of the electromotive force, which is ordinarily developed in secondary batteries of the Planté or Faure type. The result of a large number of experiments has, however, been to show that (until the couple is almost completely run down) the E.M.F. obtained from an element of lead reduced upon a surface of carbon, such element being opposed to a plate of lead with its surface peroxidised, is quite equal to that obtained with an element of lead reduced upon lead and similarly opposed by a surface of lead peroxide. Indeed, for some reason which we cannot as yet explain, the lead reduced upon carbon nearly invariably gives an E.M.F. very slightly higher than that obtained with the elements wholly composed of lead.

Anode Element (Charging).

We have thus far dealt somewhat exhaustively with the cathode and the recent attempts to improve it. Giving the reasons which led to these attempts, and stating that the results have thus far proved satisfactory, we must now turn our attention to the anode in charging. The electro-chemical difficulties in connection with the anode may be referred to the fact that peroxide of lead, the most electro-negative of all conductors, forms a local couple with the lead support with which, as well as with the electrolyte, it is in contact. The action of the local current, as is well understood, is to convert the metallic lead into lead sulphate, or lead oxide, and to reduce the lead peroxide to a lower stage of oxidation. The detrimental effect of this action is twofold. The couple when charged tends to "run down" with considerable rapidity, by the production of local currents, at the expense of the peroxide of lead and the lead conductor in contact with it. Most secondary batteries, as at present constructed, cannot therefore be left at rest after charging without some appreciable loss in the quantity of lead peroxide—that is, in the quantity of electrical energy accumulated. Indeed, the local action goes on to some extent *pari passu* with the action producing the current in the external circuit. This local action results in a very limited period in the complete disintegration, and consequent destruction, of the element, no portion of which is left unaltered to maintain efficient contact with the mass of peroxide. This is the same as saying that the Planté plate, when giving its best result, is upon the verge of destruction when it is wholly porous, and when it is completely peroxidised, then it is useless. A portion of lead must be left to act as the conductor and contact piece. The improvements then in the anode tend to allow it to retain its charge for days and weeks with but a small percentage of loss in the energy accumulated. The accumulation of energy should, unless drawn upon, be practically permanent, and this would lengthen the life of the plate, and avoid frequent inspections and renewals. There would appear to be only two possible means by which the local action in a charged-up anode can be effectively decreased, and the life of the anode be considerably augmented. These means are (1) to oppose a resistance as great as possible to

the passage of the local currents which tend to pass in the substance of the charged elements, and (2) to employ as the conductor, in contact with the active material, a substance decidedly electro-negative to ordinary lead, and therefore constituting a far less effective local couple with peroxide of lead than does metallic lead, whilst, at the same time, it is not subject to oxidation or disintegration.

Let us, then, consider briefly the use of impervious non-conducting materials in preventing local action in the element which is the anode in charging.

Let us suppose that we take as our anode plate (charging) a sheet of lead of any required size, and about $\frac{3}{16}$ in. or $\frac{1}{8}$ in. thick (rendered spongy wholly or in part), by minute perforations, a form experimented with by the writers during the past two years. Minute perforations can be machine made. If used at once as an anode without preserving precautions, this element would rapidly improve up to a certain point, when it would rapidly deteriorate by reason of defective contact with the peroxidised material, resulting from the almost complete conversion with peroxide of the metallic mass. Now, let us suppose, as was first suggested by Mr. FitzGerald, that the surface of the lead is in part protected by a sheet of impervious non-conducting material perforated with apertures, and strongly adherent to the metallic surface.

A suitable material for this protective covering should be detrimentally acted upon neither chemically by the electrolyte nor electro-chemically by the effect of the current upon the latter. In the operation of charging the exposed portions of the plate would immediately be attacked, and we may suppose the conversion taking place at these portions to have extended quite through the substance of the plate. The element would then be constituted by masses of lead peroxide supported in frames or in a lattice of metallic lead. Some amount of local action will undoubtedly take place between the lead peroxide formed and the metallic substance of the frames or lattice. In the local circuits the current passes from the unaltered metal to the electrolyte, and thence back to the metal through the peroxide. The electro-chemical effect will vary directly as the E.M.F. between the lead and lead peroxide, and inversely as the resistance to the passage of the local currents. It will result in the conversion of the metal into lead sulphate or oxide, and in the reduction of a portion of the peroxide to a lower degree of oxidation. But it is easy to perceive that as this local action extends laterally in the direction of the plane of the plate, the resistance to the passage of the local currents will become enormously augmented, mainly by the diminution of the quantity of the electrolyte, which is present in the path of these circuits; and when we consider that the depth to which the conversion produced by these currents must extend under these conditions of resistance in order to operate, the destruction of the metallic frames or lattice may be made very considerable, say from $\frac{1}{4}$ in. to $\frac{3}{4}$ in. of metal to be converted, it becomes easy to realise that the life of an element so constructed may be vastly extended. When, in fact, the destructive action has extended laterally to a depth of some $\frac{1}{16}$ in. along the interior surface of the protective covering, the action seems to be almost arrested. A secondary battery, constructed with such anodes, may, when *fully charged*, be left to rest days or even weeks without appreciable loss. After such period of rest it is expedient, if not absolutely necessary, to pass a charging current through the battery during a few minutes, in order to convert into peroxide the minute quantities of lead sulphate or oxide which may have been produced by local action. By adopting this precaution the resistance is increased, but the increase is very small, and not at all comparable with what it would be if the same course was adopted with the cathode. It is well understood, in fact, that the surface of the anode in charging may be made somewhat less than that of the cathode without any appreciable detriment. The device of partly protecting the anode surface with a view to retain unaltered metal for support and contact with the active material might, *primâ facie*, be regarded as crude and unsatisfactory. Our view is that the method is in reality based upon safe scientific principles, and this view has been confirmed by the experimental results obtained. The choice of material to be employed for protective purposes is very limited. One of the best materials hitherto tried is that known as "Prout's glue."

With regard to the second device, the use of conductors, electro-negative to lead, for the support of the active material in the anode in charging, so that a comparatively ineffective local couple is formed to cause loss, the choice of material is very limited. A metal such as copper, silver, or antimony, which forms a soluble sulphate by the effect of the electrolytic action is, of course, inadmissable. Carbon is also quite out of the question, not so much by reason of its rapid disintegration, but from the fact that lead peroxide reacts upon this element, and cannot electrically be produced in contact with it. Gold and platinum cannot be employed, not alone by reason of their expense, but because it is impossible to assume that strips or flakes of very minute thickness would be permanent under the conditions of practice. An alloy has, however, been found decidedly electro-negative to lead, and has given very encouraging results, but although we may be unable to say more in this direction, we have given our reasons for looking in this direction, and it may be that some chemist or electrician now present may be able to suggest a material which will answer the requirements.

One of the largest items in the cost of electric lighting is that representing the cost of the generation of steam. In an installation requiring only 1,000 indicated H.P., the coal consumed at the rate of 2¼ lb. per indicated H.P. per hour for an average of six hours per day throughout the year would amount to six tons per day, or 42 tons per week. For good steam coal this represents in London an expenditure of about £40 per week, or over £2,000 per year, a sum which equals 5 per cent. per annum on a capital expenditure of £40,000.

It is the object of this part of this short paper to show that the cost of electricity may be reduced by the whole of the expenses at present incurred in the generation of steam for supplying the engines by which dynamo-electric machines are driven, especially when they are used on a large scale. For this purpose reference will be made to a large boiler which has successfully produced steam sufficient for 125 indicated H.P. wholly free of cost, and which has been at work daily for considerably more than two years.

In the ordinary process of the manufacture of furnace coke a quantity of combustible gas is given off which is not utilised. By a suitable combination of special boiler with furnaces designed for the production of coke, these waste gases may be, and are, by the boiler referred to, utilised in the generation of steam.

This arrangement of boiler and coke ovens may be at once described. Referring to the diagrams on the wall, these show a longitudinal section, and a transverse section of the combined boiler and coke ovens. In these diagrams is represented a form of elephant boiler mounted over a series of 12 coke ovens, the flues from which are arranged with special relation to the flue tubes in the lower parts of the boiler, and the flue spaces round these and the upper or steam chamber. The two outer tubular boilers are provided with openings through which the gases enter the flue tube. The gases pass from the coke ovens through these two outer flues in one direction, and return in the opposite direction through the tube of the central member of the boiler. They then rise and pass in the direction shown, and finally they pass along a flue, and thence through another flue to the chimney. The four main parts of the boiler are connected by vertical necks and inclined necks. Here is shown the position of one of the trucks from which the small coal is fed into the ovens. The diagrams do not show the rising and falling doors by which the coke ovens are closed, nor do they show the details by which the gases from one oven may be for a time directed into the oven next it when the oven has been freshly loaded. These details will, however, be easily understood without description, as will also the similar details by which the greater part of the whole of the gases may be passed to the chimney when steam is not required.

Some particulars will be expected relative to the boiler by which the success of the system has been proved. This boiler is at the Lea chemical works of the inventor, Mr. Courtenay Kingsford. Its dimensions are as follows:—The boilers are—length, 18 feet, diameter 3 feet, tube 1 foot 11 inches; steam chamber, length 13 feet 6 inches, diameter 4 feet 6 inches. The total heating surface in this boiler is 956 square feet, and of this 644·5 may be taken as effective heating surface. It constantly evaporates about 300 gallons of water per hour. The output of furnace coke from the ovens under this boiler is about 160 tons per month, the product of, say, 266 tons of small coal. This is equivalent to about 8·8 tons, or 19,712 lbs. of coal coked per day of 24 hours, and as the water evaporated in the same time at the rate of 3,000 lbs. per hour is 72,000 lbs., the water evaporated per pound of coke is 3·64 lbs. Some reduction must, however, be made from this, as the full 3,000 lbs. of steam is not required at night.

The whole of the coke produced is sold in the immediate neighbourhood of the Lea chemical works for foundry, cupola, and smithshop purposes to well-known engineering firms, and as it is a good hard coke the cost of the coal used in generating the steam is recouped. Something might be told of the profit which is possible as resulting from the sale of the coke, but the importance of the system is sufficiently shown, and, moreover, the profit obtainable must be debited with the interest on the cost of ovens, which is somewhat greater than the ordinary boiler setting. It may, however, be mentioned that as the stations for the generation of electricity for lighting or for train or railway purposes must be in or near towns, it is necessary the steam should be generated by smoke-consuming furnaces. For this reason the system described is the best possible, as the whole of the smoke is consumed.

CHEMICAL SCIENCE.

Monday, September 24th.

THE ELECTROLYSIS OF DILUTE SULPHURIC ACID IN SECONDARY BATTERIES.

By Dr. J. H. GLADSTONE and Mr. A. H. TRIBE.

The authors, in their recent papers, had given the results of their chemical changes which took place in charging and discharging secondary batteries of the Planté or Faure type. In expressing these changes, by means of formulæ, they had assumed that the compound decomposed in the cell was H_2SO_4. The present communication was to consider more fully the question as to what the compound electrolysed really was. Was it water, as used to be supposed? was it the actual H_2SO_4, or was it some chemical combination of the two, such as hexobasic sulphuric acid, which Frankland has lately assumed to be the electrolyte, on the authority of Bourgoins' experiments. The authors had tested the value

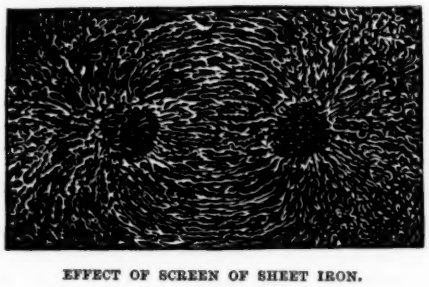
of these experiments by means of a divided cell, in one limb of which was a solution of sulphate of copper, and in the other dilute sulphuric acid. It was found that, independently of the actual molecular change during electrolysis that must ensue in connection with it, in accordance with Grothus' hypothesis, there was also an actual passage of sulphuric acid into the limb containing sulphate of copper. The conclusion from this and other experiments was that the authors have no data to determine whether it is sulphuric acid or some hydrate that is electrolysed. The analogy would lead to the conclusion that it is sulphuric acid itself.

(To be continued.)

THE MAGNETOPHONE.

IN the ELECTRICAL REVIEW for September 8th, 1883, we published a short note on the subject of this apparatus. Mr. H. S. Carhart, of Evanstown, Ill., the deviser of the instrument, describes and illustrates his experiments more fully in *Science* of September 21st. The author says :—The experiments of Bell, Preece, Mercadier, and others on the radiophone, suggested to me the possibility of interrupting, or at least periodically modifying, the lines of force proceeding from the poles of a magnet, by means of a disc of sheet iron, perforated with a series of equidistant holes, and rotated so that the holes should pass directly in front of the magnetic pole. It is well known that an armature, placed on the poles of a permanent magnet, diminishes the strength of the external field of force by furnishing superior facilities for the formation of polarized chains of particles from pole to pole. This is the case even when the armature does not touch the poles, but is in close proximity to them.

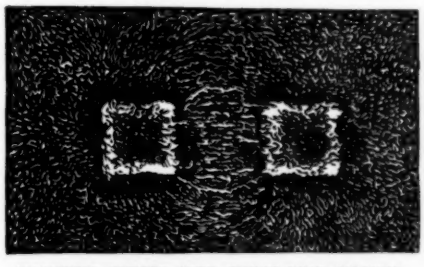
If a piece of sheet iron be placed over the poles of a magnet without touching, and the magnetic curves be developed on paper above the iron, they will be found to exibit less intense and less sharply defined magnetic action than when the sheet iron is removed. If, however, a small hole be drilled directly over each magnetic pole, the screening action of the sheet iron is modified in much the same way as when a hole is made in a screen opaque to light ; for the developed curves show distinctly the outline of the holes. If, therefore, the sheet iron in the form of a circular plate, pierced with a number of holes, be rapidly rotated between the pole of a magnet and a small induction bobbin, the action of the magnet on the core of the bobbin will be periodically modified because of the passing holes ; and hence induced currents will flow through a circuit including the bobbin. A disc of sheet iron was pierced



EFFECT OF SCREEN OF SHEET IRON.

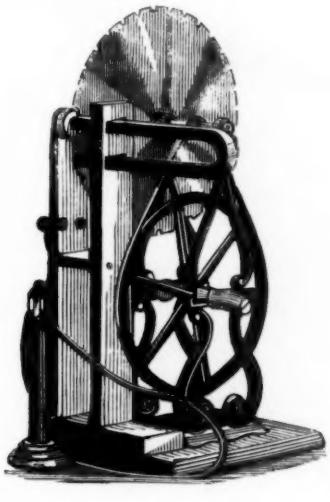
with two circles of quarter-inch holes concentric with the disc, the number of holes in the two circles being thirty-two and sixty-four respectively. On one side of the disc was placed a horse-shoe magnet with its poles very near the rows of holes ; on the other side were arranged two corresponding induction bobbins. The circuit was completed through a telephone and either bobbin at pleasure. Upon rotating the disc rapidly, a clear musical sound was produced in the telephone, the pitch rising with the rapidity of rotation. Moreover, the bobbin opposite the circle of sixty-four holes gave the octave above the other, and each gave a note of the same pitch as was produced by blowing a stream of air through the corresponding holes. Hence, as a beam of light, focussed upon a circle of equi-distant holes in an opaque disc, is rendered periodically intermittent by the rotation of the disc, and produces a musical tone when falling upon the proper receiving apparatus, so the lines of force proceeding from a magnet may be rendered periodically intermittent in their action on an induction bobbin by a similar metallic disc, set in rapid rotation ; and the induced currents, arising from the periodic change of magnetism in the core of the bobbin, produce a musical tone in a telephone, the pitch depending in both cases only upon the number of holes passing in unit time.

The experiment was modified by so placing the poles of the magnet that the same circle of holes passed them in succession. By the proper connections, the currents from the two bobbins were made to pass either in the same or in opposite directions through the telephone. In the latter case, an almost perfect neutralization of currents took place, so that the sound was scarcely audible.



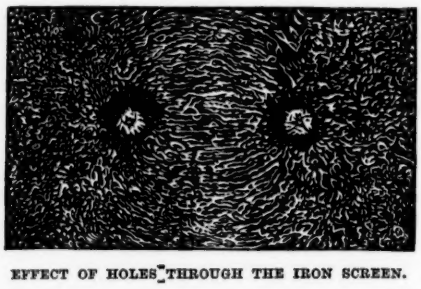
MAGNETIC CURVES OVER HORSE-SHOE MAGNET.

Non-magnetic metallic discs produce similar musical notes by the periodic modification of the magnetic field by means of the distortion or bending of the lines of force. The solid parts of the conducting disc deflect the lines of force in the direction of the rotation, but upon the passage of a hole they fall back towards their normal position. A periodic movement of the lines of force will, therefore, take place when the disc rotates. Discs of zinc and copper produce a clear musical sound, somewhat less intense than that given by iron under the same conditions. Any discontinuity in the rotating disc recurring periodically will produce corresponding induction currents in the bobbins. Thus, V-shaped notches round the circumference



of the disc are quite as efficient as the holes in effecting the requisite modification of the magnetic field. Moreover, it is not necessary that the holes extend entirely through the disc. Two discs of zinc, of the same diameter and thickness, were placed together on the same rotating spindle, one pierced with a circle of holes, and the other not. The combination proved as

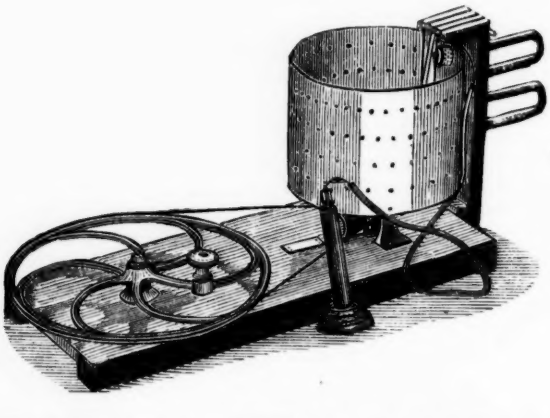
efficient in producing the sound as the single perforated disc. A sheet of tinfoil, with a circle of small holes, was pasted on the continuous zinc disc. The perforations, extending only the thickness of the tinfoil into the compound disc, constituted a sufficient discontinuity to produce a clear, though somewhat faint, musical sound. About the same result was given by a disc consisting of the same sheet of tinfoil pasted on cardboard.



EFFECT OF HOLES THROUGH THE IRON SCREEN.

Any periodic variation from uniformity in the disc appears to produce corresponding variations in the magnetic field when the disc is rotated. Depressions made with a punch, at regular intervals, in a zinc disc, rendered it a sound-generator when rotated in this apparatus.

Since the pitch of the note obtained depends only on the number of holes passing the pole of the magnet in a second, it is easy to construct a piece of apparatus to illustrate musical intervals. A cylinder of galvanized iron, with four rows of holes in the ratio of 4 : 5 : 6 : 8, was mounted on a whirling table, and provided with two U-magnets and two electro-magnets for induction.



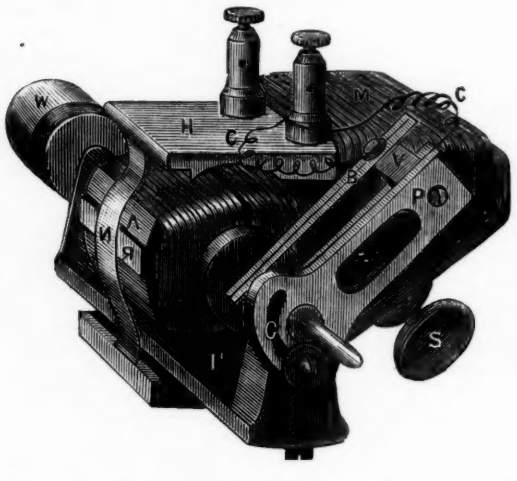
The latter were placed inside the cylinder, and the former outside. By means of four keys, any one of the bobbins, or all of them, can be put in circuit with the telephone. By depressing the keys, the four notes of the common or major chord are brought out with great distinctness and clearness. In fact, the intensity of the sounds obtained by the magnetophone is sometimes so great as to be painful to the ear when the telephone is held closely against it.

The above experiment was simplified by employing a disc perforated in four concentric circles with 24, 30, 36, and 48 holes respectively. A telephone with the mouthpiece and diaphragm removed, was presented to the four rows of holes in succession, with the production of the four notes of the major chord as before, clearly defined, but not so loud as with the other apparatus. Further experiments are in progress.

Decorations. — The Indian Government has sanctioned the granting of medals to civilians connected with the Indian Postal, Telegraph, Survey, and Political departments of the Civil Service who may in future be engaged in active warfare.

THE GRISCOM "V" MOTOR.

THE new Griscom "V" motor consists of a V-shaped magnet, H, I, wound with a single coil, M, the lower pole of the magnet having been extended so as to support the bearings of a Siemens' armature, A, revolving freely in either direction between the poles. The single coil, M, has been found capable of developing sufficient magnetic attraction at the poles, and the armature is connected in series with it. A block of vulcanized fibre, V, carries the brushes, B, and is supported by the piece, P, which can be shifted around a third of a circle, along the slot, G. This complete movement reverses the polarity and consequently the direction of the revolving armature, and a partial movement reduces the speed, all of which can be done instantly. The ridge, R, on the armature is $\frac{1}{32}$ of an inch in height, but catches the air enough to keep the magnet coils cool, and enables them to carry a greater quantity of current than before this improvement was



introduced. This is a very essential feature, as the highest efficiency is said to be obtained from the motor when worked to the maximum carrying capacity of the wires (without overheating). The brace, N, is of brass and gives rigidity to the magnets, while protecting the armature. A screw, S, serves to fasten the motor to the machine to be driven. The weight of this motor is exactly 1 lb. 10 oz., and its efficiency is stated to be 80 per cent. of that of the original type of the Griscom motor. It has been made to meet a growing demand for a cheap and efficient machine. The current required to drive a sewing machine is the same as the ordinary Griscom—6 bichromate cells, about 12 volts and 2 ampères. The resistance of the motor is less than 1 ohm. It is machine made, simple in construction, and all parts are interchangeable.

NYSTROM'S TELEPHONIC SYSTEM.

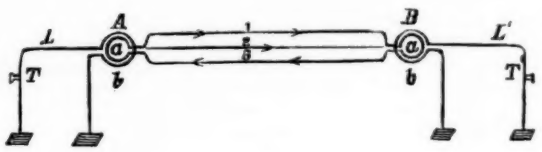
WHEN there are several line wires on one line of poles simultaneous telephonic communication on two or more conductors is rendered difficult, or even impossible, in consequence of the communication passing through one wire being heard on the others, an inconvenience which, however, can be remedied, as is well known, by employing a return wire for each telephonic circuit in the place of the earth. This arrangement should be so arranged that the telephonic current goes in opposite directions through the two wires.

In order to take advantage of this combination, when it is employed to work between two telephonic centres, the subscribers being connected to the latter by single conductors, I have devised the following arrangement, based upon experiments which I have already described.

An induction bobbin, *a*, *b*, the coils of which are adapted to the resistances of the wires they are required to work over, is placed at each of the telephonic centres, A and B. One of the coils, *a*, of each bobbin is placed, in the manner indicated by the figure, in permanent communication with the double conductor between the centres. One end of the second coil, *b*, is in permanent connection with the earth at the central stations. The ordinary commutator of the stations allows any single conductor to be placed in connection with the second end of the coil, *b*. The further extremities of the subscribers' lines are connected to earth in the usual manner.

The current which is produced when subscriber, T, telephones over his local conductor, L, circulates through the coil, *b*, and acts by induction on the coil *a*. The result, as indicated by the arrows in the figure, is that a current circulates in the wires 1 and 3, which are connected through the coils, *a*, *a*. This current which, at the opposite station passes through the coil, *a*, produces there, in its turn, an induced current in the single conductor, L, which is in communication with the subscriber, T^1. By this means several double conductors can be simultaneously employed for telephonic purposes, without the disturbances first referred to, taking place ; and, moreover, a conversation can be held by means of a single conductor between two central stations, although the electric currents between the earth plates of this single conductor produce a considerable disturbance.

The figure shows a single wire, 2, placed midway between the two wires, 1 and 3, which form the double conductor. The wire, 2, exercises, it is true, an inductive action on wires 1 and 3, but this action is such that the effect on one wire is neutralised by the effect on



the other. In the same way wires 1 and 3 act by induction on wire 2, but the effects being equal and opposite no disturbance is produced. It is a remarkable fact that it is not necessary for wire 2 to be placed *between* the others ; it will answer equally well if it is placed below them.

The intensity of the sound is not materially affected by this double translation system ; in fact the effect is as good as that obtained on a single conductor. This fact is the more remarkable as the currents produced from an ordinary induction apparatus at one of the stations are too enfeebled by the translation in question to produce the ordinary signals at the two stations. Moreover, this circumstance necessitates special arrangements for call signalling between the two stations. The best arrangement to adopt for this purpose is to employ a special wire, common to all the systems of double conductors. In this way the number of wires necessary would be the double of that of the telephonic communications which can be carried on simultaneously.

In connection with the preceding, I may relate another practical experiment. A telephonic line with four wires has been established this year between Malmö and Lund (Scanie), in order to connect the works of these two towns, situated at a distance of 18 kilometres from each other. Each pole has been coated with a sheathing of zinc to a distance of a metre from the top, and this sheathing has been placed similarly at each pole, in connection with the earth, by means of iron wire about 6 centimetres in diameter. The object of this arrangement is, in the first place, to prevent conduction along the poles from one wire to the other, and also to act as a lightning discharger. When, at the commencement of July, the line had been employed for telephonic purposes, it was immediately found impossible to use two or more conductors for simultaneous communications. Even when only the upper and lower wires were employed, a telephonic communication on one of the wires affected very considerably a communication on the other. It appeared then that the supression of conduction along the poles did not prevent the transmission of the telephonic effect from one wire to the other. It was then that recourse was had to the induction arrangement described, and experience has proved that it entirely answers the required purpose.—*Journal Télégraphique.*

[An arrangement similar to the foregoing was devised by Mr. Bennett, and has, we believe, been in use for the past two years in this country.—EDS. ELEC. REV.]

THE PORTRUSH-BUSHMILLS ELECTRICAL TRAMWAY.

THEIR Excellencies the Lord Lieutenant of Ireland and the Countess Spencer opened this tramway on Friday, the 28th September. It is the first electrical tramway attempted as a permanent commercial enterprise and is by far the longest yet made, being over six miles in length from the generators at Bushmills to the station at Portrush. Besides its length, the very steep inclines, one as steep as 1 in 28, and the sharp curves, make it a very difficult line to work, so much so, indeed, that Sir William Siemens, in his speech at luncheon, said that is was fortunate that Mr. William Traill, the engineer of the line, had not told him of these difficulties at first, or he would probably have declined trying his first experiment under such very difficult circumstances. In addition to the natural difficulties, very unnatural ones have been thrown in the way of the promoters by local opponents, but it is to be hoped that this kind of opposition will no longer be heard of, as its futility has been so conclusively demonstrated.

The morning of the day of the opening ceremony was beautifully fine, and presented a delightful contrast to the preceding days of storm. Their Excellencies arrived at Portrush punctually at 12 o'clock and were received by a deputation representing the inhabitants of Portrush, who presented them with an address of welcome. A steam-tram was in attendance at the railway station which conveyed the viceregal party through the town to the tramway depôt. This was necessary, because it is not at present practicable to bring the cars through the town by electricity, as the third raised rail would be very much in the way in the streets. It is intended shortly to work the short terminal town ends at Portrush and Bushmills by accumulators. On arrival at the tramway depôt, their Excellencies inspected the stationary steam-engine and dynamo that had been used in making the experiments on the line before the turbines and large dynamo at Bushmills had been erected. This concluded, the viceregal party with the chairman, Dr. Traill, F.T.C.D., Sir William Siemens, Sir William Thomson, &c., proceeded into the first electric tramcar, which was conducted by Mr. W. A. Traill, the company's engineer. Two other electric cars were filled by other distinguished visitors, about 20 in each, and were followed by a steam-tram bringing the rest of the party, upwards of 100 in all. His Excellency then started the first car, which glided away amidst the cheers of the bystanders. The motion is so smooth and the absence of any apparent cause of motion so remarkable, that everyone who experiences travelling in an electric car for the first time is sure to be filled with surprise at the novel sensation, and the viceregal party were no exception to this rule as they were carried along one of the most beautiful sea-roads in the world, up steep hills and round sharp curves, past those remarkable rocks of white chalk overrun by black basalt, and past the crag-perched, sea-lashed castle of Dunluce, down to the village of Bushmills, famed for salmon, Orangemen, and whiskey. The first

car having past the first steep incline, the second car started and was similarly followed by the third car and the steam-tram. They all arrived safely at Bushmills, thus showing the possibility of driving three cars on a very difficult line for a distance of nearly six miles by electrical power. The time occupied in doing this was about three-quarters of an hour.

On arrival at Bushmills, carriages were in waiting to carry the party to the salmon leap (about three-quarters of a mile from the end of the line), where the turbines and dynamo are situated that supplied the power which moved the cars. Dr. Traill drove their Excellencies in his carriage by a lately-constructed road along the edge of the precipice, close above the foaming river, swollen by the late rains, right up to the dynamo-house. Here they inspected the turbines and dynamo, and Sir William Thomson sacrificed himself, to prove the absolute absence of all danger from the mild shocks given by an electromotive force of 250 volts, by holding a terminal of the dynamo in one hand and shocking any member of the party he induced to shake hands with him through the other, to the no little amusement of those present who were not subjects of the experiment.

From the turbines the party proceeded in carriages to the Giants' Causeway Hotel, where they were regaled at a sumptuous luncheon. After luncheon the following toasts were drank enthusiastically: "The Queen and the Royal Family," proposed by the Chairman, Dr. Traill, F.T.C.D., who followed it by proposing "The Lord Lieutenant and prosperity to Ireland;" to which his Excellency replied in a speech in which he expressed a hope that the Tramways' Act of last session might be of service to the country, but warned all against professional promoters, holding up the Portrush and Bushmills Tramway as an example how local effort, judiciously directed, could utilise the water-power of the country to increase their means of communication. He concluded by proposing "Success to the Electric Tramway Company;" to which the chairman and Mr. W. A. Traill responded, showing how determination and persistency had overcome all their difficulties and produced a work which was not only scientifically, but financially successful, the receipts having progressed since the commencement, and being now at a figure which foreshadowed substantial dividends. The chairman then gave "The Houses of Parliament" and, finally, "Science in its practical application," to which Sir William Siemens replied, congratulating everyone concerned on the complete success of their persistent efforts to overcome the many difficulties that surrounded them in this grand attempt to utilise water-power as a means of locomotion. He explained how economy resulted even though there was a loss of 50 per cent. in the conversion of energy, owing to the greater cheapness of water-power and stationary engines, and especially in the saving of the carriage of an engine, which otherwise would have to be brought along the line up hills and round curves, though not required at the other end except for the purpose of bringing it back again. Sir William Thomson and Sir Frederick Bramwell were to have replied to this toast, but time forbad more delay and deprived the world of an opportunity of hearing their remarks on this wonderful undertaking. Sir William Thomson, however, insisted on calling on the company to express their sense of regard for Dr. Traill and the other promoters of this difficult undertaking which they had brought to such a very successful conclusion.

The party then returned in carriages to Bushmills and thence by the three electric cars and a steam-tram to Portrush, whence a special train conveyed the vice-regal party to Downhill, where their Excellencies were the guests of Sir Hervey Bruce, Bart., M.P. Sir William Siemens, Sir William Thomson, Dr. Carpenter, Prof. Fitzgerald, F.T.C.D., Sir Frederick Bramwell, Dr. Robert McDonnell, and other scientific gentlemen, were the guests of Dr. Traill, F.T.C.D., the chairman of the company, at Ballylough House, his beautiful country seat, which is situated about three miles from the Giants' Causeway.

Thus was opened the greatest electric tramway yet existing, and though a few difficulties, such as going through the towns, still require to be overcome, yet all those concerned may well congratulate themselves on the great success that has rewarded their labours.

THE ELECTRICAL TRANSMISSION OF POWER.

EXPERIMENTS MADE AT GRENOBLE BY M. MARCEL DEPREZ.

M. BOULANGER in *Comptes Rendus*.

I HAD the honour of making known to the Académie, in a previous communication,* the results of the dynamometrical measurements made at Grenoble upon the electrical transmission of power. The present note relates to the electrical measurements and to the experiments on distribution.

During the whole of the experiments, two galvanometers (Marcel Deprez system) were included in the circuit, one at Grenoble, the other at Vizille, and these two instruments indicated constantly that the difference of intensity at the two ends of the line was but small. Unfortunately, the apparatus did not give great accuracy in its readings, so that, to determine exactly the value of the losses by the line, we had recourse to the chemical method.

Two voltameters formed of plates of pure silver dipping into a solution of nitrate of silver were placed at the ends of the line. The plates had a surface nearly a decimetre square and the current was furnished by the generator at Vizille. At Grenoble, the circuit was closed by an inert resistance. As these experiments were intended to take place at the same time as those with the galvanometers, these were placed at the side of each voltameter.

Two experiments of changing the speed of the machine were made and the results contained in the subjoined table were obtained:—

Number of the Experiment.	Position of the Voltameters.	Weight of the positive Electrode. Before the Experiment.	Weight of the positive Electrode. After the Experiment.	Difference of Weight, p.	Duration of the Experiment in Seconds, t.	Intensity, $\frac{p}{0{\cdot}0011248 \times t} = I$.	Electromotive force of the machine, E.	Difference of Potential at the Terminals, $E - RI = U$.	Remarks.
		gr.	gr.	gr.		amp.	volts.	volts.	
1	Vizille ...	39·43959	26·20184	13·23775	3600	3·268	2808	2627	The number 0·0011248 gr. taken for the weight of silver deposited per ampère and per second, was given by M. Mascart.
	Grenoble...	39·78262	27·22920	12·55342		3·099			
2	Vizille ...	36·03719	27·32190	8·71529	2205	3·514	3128	2934	
	Grenoble...	34·68220	26·54200	8·14020		3·282			

In order to determine the value of E, we admit, what has been proved upon the same machines, by the experiments made at the workshops of the Northern Railway, that the electromotive force is proportional to the speed, N, provided that the intensity does not vary. A series of 12 experiments, made by inserting variable resistances into the circuit of the generator, enables us to construct a curve having for the abscissae the values of I, and for ordinates the corresponding values of $\frac{E}{N}$.

* See ELECTRICAL REVIEW for last week.

We can then, by the aid of this curve, easily deduce the electromotive force from the speed of the ring for all the other experiments.

It follows from the Table that, in the first experiment, the loss of intensity was 5·1 per cent. In the second experiment, where the difference of potential at the terminals was nearly 3,000 volts, the loss was 6·6 per cent.

The other electrical measurements are supported by nearly forty experiments and allow, by making use of the mean intensity, of calculating the values $\frac{E\ I}{75\ g}$ and $\frac{e\ i}{75\ g}$ of the electrical work (the electromotive force, e, of the receiver was deduced from E, by the equation, $e = E - A\ I$, A being the total resistance, $R + r + \rho$, including the machines and the line) as well as the electrical rendering $\frac{e}{E}$. The result of these calculations shows that the electrical rendering scarcely differed from the mechanical rendering.

Besides, the comparison of the electrical work and the mechanical work shows that the coefficient of transformation of the generator is very near unity, so that the deficit comes almost exclusively from the receiver.

The second part of the experiments was devoted to distribution. The receivers used were three Siemens' machines and two Gramme machines (workshop type). All these machines having thick wire, it was necessary to employ a thick-wire generator; this was a Gramme machine, of which the inductors were strengthened and provided with double winding (Marcel Deprez system). The constant current was furnished by a second machine, which served for the exciter, and both machines were worked by means of an engine which kept the generator at such a speed that the difference of potential at its terminals might remain constant.

The derivations of the machines branched out from two parallel wires which were carried from the two terminals of the generator. The difference of potential at the terminals was measured by a galvanometer placed in derivation. A second similar galvanometer allowed of measuring the difference of potential at the end of the line. Lastly, the intensities were measured by a thick-wire galvanometer of unappreciable resistance.

Each machine was furnished with a Carpentier brake, carrying a constant load of 2 kilogrammes. The pulleys of the brakes having 1 millimetre circumference, the work per second was given in kilogrammetres by the equation $\frac{2n}{60} = \frac{n}{30}$, n, being the number of revolutions per minute.

The measurements were made by joining on the machines one after another; we had thus a series of five experiments, of which the results are given in the subjoined table :—

Number of the experiments.	Number of revolutions per minute of the generator.	Difference of Potential.		Receiver No. 1.		Receiver No. 2.		Receiver No. 3.		Receiver No. 4.		Receiver No. 5.		TOTAL WORK.	TOTAL INTENSITY.	REMARKS.
		At the terminals of the generator.	At the end of the line.	Work per second.	Intensity.	Work per second.	Intensity.	Work per second.	Intensity.	Work per second.	Intensity.	Work per second.	Intensity.			
		volts.	volts.	kgm.	amp.	kgm.	amp.	kgm.	amp.	kgm.	amp.	kgm.	amp.	kgm.	amp.	
1.	2,230	39·4	39·1	18·0	9·7	...	...	...	...	...	...	...	...	18·0	9·7	The load of each brake was 2 kilogrammes.
2.	2,270	39·0	38·8	18·9	9·9	19·6	11·3	...	...	...	...	...	...	38·5	21·2	
3.	2,238	39·3	39·1	18·6	9·9	19·5	11·3	42·5	18·3	...	...	...	...	80·6	39·5	
4.	2,238	39·0	38·8	17·6	9·9	19·1	11·5	40·0	17·5	39·5	19·0	...	...	116·2	57·9	
5.	2,169	39·1	39·1	18·5	9·5	18·7	10·6	40·0	17·2	34·7	18·6	35·3	19·3	147·2	75·2	

We see by this table that, for one machine, the work produced and the intensity of the current did not vary to any considerable extent; the machines were therefore independent from each other, and there was actual distribution.

DUNDEE UNIVERSITY COLLEGE.

FRIDAY, 5th October, 1883, will henceforward appear in red letters in the annals of Dundee. In addition to conferring the honour of the freedom of the burgh on the Earl of Camperdown and the Earl of Dalhousie the new University College was formally opened. By noon on Friday, upwards of 1,000 ladies and gentlemen had assembled in the College Hall, to take part in the opening ceremony, which was performed by the Earl of Dalhousie, and to hear Professor STUART, of Cambridge, deliver the inaugural address. The subject matter of the address, which throughout was characterised by careful thought and great ability, space does not allow of our giving a verbatim report, but the following extract will be interesting to our readers :—

"We have come to a time when there is a great change in human knowledge; when the occupation of the mechanic, of the artisan, of the busy and varied life of our cities, has begun to have new light break on it, has gradually grown into being capable of being systematised. A science is found to underlie and to throw light upon labour. The material part of human life calls for its scientific treatment, and is capable of it. This is the age, then, of a new University movement, which, in all directions, is manifesting itself, either by additions to existing Universities or by the foundation of new ones. This is the time when again the force of a new light is making men missionary, and new "faculties" are being founded, careless of the Pope's permission to teach, seeking, therefore, not necessarily any degree, but seeking the right to teach by acquiring the necessary knowledge; and institutions are arising whose object is, as 800 years ago, to give the people what they seek, namely, the scientific basis of the occupation which is to be theirs in life. The demand arises, too, from all classes of society, and it arises simply because now, for the first time, it is beginning to be possible. This demand is what is called at the present day the demand for technical instruction, and which is pointed out in the first sentence in your calendar as one of the causes which has led to the foundation of your College. This College is part of that great new educational movement which is just beginning to feel its way, so to speak, into life. Like the ancient University movement of 800 years ago, it is arising, not in any one nation alone, but simultaneously throughout Europe. It is a part of the great forward, onward movement of men's minds, a step in modern civilization; and all such steps are common to the nations. It is the gaining of one other part of human life to a thoughtfully ordered scientific whole, it is another mountain top still farther to the west, touched with the slowly rising sun of human progress. And it has this inestimable characteristic, that it descends right through the masses of the whole people. This movement in which your College has consciously taken part is a movement in keeping with the time. These are democratic days—the days of privilege are numbered. Whatever is done must be done for the people, not for the few; and the new demand for a new scientifically ordered education comes from the great body of the people, and not only from the cultured few. It arises in great towns; it must be met in these great towns. It has all the characteristics of the new life of the age. So here, then, we must raise into existence a new class of education, a new scientifically ordered system of thought, a new faculty—the faculty of applied science—which shall not necessarily follow on any of the old lines, but shall shape its existence and its form by the answer to the all-important question, What do the people need? That is the consideration which ought to govern, as I feel sure it does govern, the counsels of this College, and not the question, How shall we best imitate this or that existing system or prepare for this or that existing degree. There must

be boldness and freshness of conception always among those who launch out as the early pioneers on a wide and unknown sea. That boldness and freshness of conception must be yours. The buildings of the past are only the quarry and not the model for the new buildings you are to erect. But the spirit which guided the formation of the education of the past is the spirit which will guide you rightly—the spirit which asks the question, What do the people need?"

WHAT IS MEANT BY "TECHNICAL INSTRUCTION?"

"It will not, I think, be useless or inappropriate if I say a few words on the subject of technical instruction. The phrase is one which is often used, and there is so much vagueness of conception as to what is meant by it—some people meaning one thing, some another—that it may be at least a contribution to the question if I say what I understand by it, the more so as it obviously is a matter which deeply concerns your College; and I do not think that in doing so I shall have anything to say which will be inimical to what you have in hand, for it seems to me that the efforts you purpose making, both from what I have seen in your calendar and of the preparations at the College itself, are entirely in the right direction. Still it is well, in beginning a new undertaking, to form if possible a complete conception of it right out to its finished condition; for even though we may, before all is done, find that we have to depart greatly from this anticipatory sketch, yet it serves as a means often of guiding and steadying our efforts at times when any other more immediate guidance is not forthcoming. In the first place, it is well to lay down distinctly what, from my point of view, technical instruction, as we mean the phrase when we speak of it as a new organization, is unable to do. It cannot teach a man his trade—he must learn that in the workshop. No technical institution alone could ever make a man a good workman, or ever teach a master all he needs to know. That which is to be done by the trained hand and the trained eye, on the one hand, and that which relates to the economic organization of a manufactory, on the other hand, is only to be learned by practice. Nothing, then, that I am going to speak about can ever supplant the workshop training; all it can do—and that is much—is to supplement that, render it more efficient, and illuminate it. No doubt the training of apprentices in workshops themselves in the purely mechanical part of their work is a matter which in many cases, and more especially in some trades, admits of a good deal of improvement; and there certainly are cases, in some trades especially, where a good deal may be done to assist the workman by some specially provided workshop, where some points may be learned which are apt to be omitted, where some process may be slowly gone through and explained which is too rapidly gone through to be understood in the workshop, or where some machine may be dissected which is not usually taken to pieces. But these assistances to manipulation are really in their nature supplementary only to the workshop training, which must be the real school of all good workmanship. But what we can give by technical instruction—what we can contribute to the workman by a teaching institution—is to sharpen his faculties of observation and reasoning to give him an elementary knowledge of the laws that govern the material world in which he works, such as may enable him to reason about it rightly. In fact, to supply him with a mind trained, but trained specially in the matters with which he has to deal. We have to do for the workman precisely what the University of Bologna did for the lawyers, and give him a knowledge of the scientific basis of his work. From what I have said it will, I think, be clear that I regard the basis of technical teaching to be the treatment of the abstract principles of the sciences which underlie the work in which the pupil, whether ultimately to be a labourer or a master, is to be engaged. Now, with few inconsiderable exceptions, the various industries of modern times, which call for and are capable of scientific technical treatment, are based upon the following sciences:—*Chemistry, Heat*, and, that which is almost a separate science now, *Metallurgy, Electricity and Magnetism*, and *Mechanics*, together with *Drawing* and a certain amount of Elementary Mathematics. The groundwork of all technical teaching, therefore, I regard to be the establishment of good classes of an elementary character in these subjects, which should there be taught in their general scientific form. The best thing we can do for the improvement of technical education is to teach these subjects, to teach them broadcast among the community, so that we raise up a whole people saturated with the elementary scientific ideas which these subjects imply. True technical education is, therefore, at its basis a general scientific education."

DIFFERENCE BETWEEN EDUCATION AND A KNOWLEDGE OF FACTS.

"I do not approve of the idea which would isolate parts of each of these sciences and teach these parts alone as being suitable for and immediately applicable to this or that particular trade. That is to deprive the thing of its true character. Selections and scraps of science taken out of it for a special purpose are not science, and do not form the true basis of scientific knowledge. The general principles of any science form a coherent whole, and these hang together and should first be acquired. We have here all the differences, between education and information. A man may possess the knowledge of a large number of isolated facts—most of our workmen do—but he may not be able to reason from these to others or appreciate their mutual interdependence. The reason why an educated man can do that is simply because he is supplied with a grasp of the principles on which that interdependence hangs. When I thus say that the groundwork of technical teaching ought to be abstract science, I do not mean that that science should avoid reference to the illustrative facts of special trades. On the contrary, one of the great progresses of recent years, which is rendering technical education much more of a possibility, has been the change in the character of facts which, in our text-books, are taken to illustrate scientific principles. These illustrative facts used to be taken from the laboratories of the learned, whereas now, in our text-books, we find them largely taken from the workshop of every-day life. For instance, take the laws of motion, a full and scientific appreciation of which is so fundamental to nearly all technical education. In text-books of twenty-five years ago these were invariably illustrated by experiments to be performed in a laboratory, by the fall of bodies in a vacuum, by the motion of pendulums, by observations in astronomy—these are good and satisfactory illustrations; but in more recent text-books I find them equally well illustrated by railway trains and rotating fly-wheels. Science is science, on whatever facts it be founded, by whatever illustrations it be brought home to us; and the peculiarity of the science taught to the special artisan ought not to be that it applies only and specially to his trade, but that it is illustrated and brought home to him by illustrations borrowed from his trade, and thus he is taught to apply it to what is actually around him. But this is a change which is coming rapidly over all science itself, namely, that it is becoming much more practically applied, so that the illustrations intelligible to the artisan are becoming gradually the natural illustrations employed in the abstract science itself. In fact, it is just this mutual approach, that science has on the one hand become more practical, and that manufacture has on the other hand become more scientific, that makes it possible for technical education to exist, and gives rise at once to the demand for it and the possibility of the supply of that demand. Just as it was 800 years ago in Bologna with the study of law."

SCIENCE IN THE WORKSHOP.

"In order to illustrate efficiently scientific principles by means of a man's work, and thus to give him the habit of elucidating his work by means of these principles, it is very desirable that the scientific teacher should ascertain from his pupils personally from time to time what work they actually are engaged in in their workshops, and he should suggest to them certain points in it for consideration. These are problems, as it were, for them to solve; this nurses the growing notions in the pupil's mind, and helps him to see *how* to utilise his knowledge. I have been so impressed by experience with the practical utility of this step that I have for my own pupils in Cambridge—there being no engineering workshops there—erected an engineering establishment into which I turn them as pupils, and my assistants follow them through their work, from time to time point out things in their work which can be elucidated by theory, and thus turn their minds directly into seeking always how to apply their knowledge, and how to interpret by it the work that passes through their hands. I have found this—which I now carry out on a large scale—most successful. I find it makes fruitful the abstract scientific principles they have already acquired in a way which is in some cases almost astonishing. It gives a new life both to the science and to the work. It teaches them to think, and involves the true principle of education, which is to help the pupil to learn from his own mistakes without permitting these mistakes to be fatal. I do not see why a great deal of the same work might not be carried out in any workshop, though, of course, on a different scale, among any apprentices who had acquired the scientific groundwork of information which I have already referred to. In any case it will be evident from what I have said that so far from considering it a disadvantage that a man should acquire his scientific knowledge while he is working at his trade, I regard it as the right way for him to learn. And it is, in my opinion, a great advantage that the more technical section of any university shonld be situated in a large industrial town, so that those actually engaged in work can attend evening classes. I have thus spoken of two points of technical education—first, the acquisition of elementary scientific knowledge; second, the application of that knowledge to bring it to bear on problem after problem in a man's own trade. Both of these are highly useful to the individual workman. And you will thus see that I do not regard the acquisition of a number of isolated technicalities, so to speak, as in any case to be aimed at by a technical school. If I wanted to have two pieces of iron welded together, for example, I would engage a smith who had been brought up in a workshop to do that, and not a man who had been told how to do so in a lecture, even though the latter knew many more technicalities about it than the smith; but I would, among smiths, vastly prefer the one who had some knowledge of the chemical properties of his iron and his fire, and still, most of all, if I knew his mind had actually been directed to consider these properties with a view to their practical effect. This exactly shows, therefore, what I would aim at doing in a technical school for the smith. In the case of those who are to be overseers, or masters, or designers, the groundwork required is precisely the same as in the case of workmen, namely, a thorough elementary scientific training; the only difference between the day science classes in a technical school and the night classes, therefore, ought to lie in the fact that the former would naturally go somewhat further. The application of their science to their work, too, ought to be carried much further, and special classes should be held in the application; thus, the engineer who has learned mathematics, mechanics, and drawing ought to begin at a very early period to directly learn how to apply these to designing machinery or constructions of some kind, or a kind of instruction which is not necessary for the workman, unless in his capacity as capable of

rising to a higher position. And, lastly, there is another piece of instruction, fitted also rather for the overseers and masters than for the workmen as such, and one in which our masters, overseers, and designers are often painfully deficient—instruction which shall apply scientific principles to the operations of a trade as a whole, and by which information shall be given of the practices of other countries and the history of the manufacture. This supplies on the spot much that can otherwise be only earned by travel or by personal inqniry; although, in the case of those who can afford it, I would always look on travel to see the trade in other places and countries as the crown of a technical education, and foreign travel, if it have some object, is one of the most efficient measures not only of technical but of liberal education. But let me, before I leave it, warn you in this matter of technical education against being misled. No technical school can ever, as a general thing, supply men with a knowledge of the best practice in any given trade, that is constantly changing, often concealed, and for the most part a knowledge of it cannot be expected of any technical teacher, or of any except the most successful manufacturers themselves. But what the technical institution can supply is the ability to detect, understand, appreciate, and apply the best practice when we see it, and the ability ourselves to improve the practice which has been transmitted to us."

ELECTRICITY AS A MOTIVE POWER.

In connection with the opening of the new Dundee University College, as above, Professor EWING delivered to a large audience a lecture on "Electricity as a Motive Power."

After reviewing the remarkable advances which the last five or six years have witnessed, the lecturer said he wished to draw their special attention to a part of the subject which had up till now attracted comparatively little popular notice—namely, the electrical transmission of power, in which he considered there were even greater possibilities of development than there were in electric lighting. The lecturer explained that in all transmission of power there was inevitably some loss, and one of the most important considerations in the design of any method of transmission was the reduction of this loss to its lowest value. In the electric transmission of power they had first to convert the energy of work done by the prime mover in an electric current convey that to the place where power was wanted, and reconvert it there into a mechanical form by an electric motor. Old and new forms of motors were described, and it was stated that the loss in the whole process was reducible to something like 20 per cent. in favourable cases. An experiment was then shown in which a current derived from a dynamo working in Mr. Brownlee's woodyard was used to drive a motor on the lecture table, the motor being in gear with a turnip-cutter. A number of other illustrations were given, in which the same current was used to drive other motors, whose power varied from that of one-horse down to about one-eighth of one-man power. In small motors the fraction of the whole energy which the machine reproduced was less than in the case of large motors, but their great convenience for many purposes often counterbalanced this disadvantage. An emery wheel and a circular saw were shown driven at a great speed by a small half-horse power motor. The lecturer went on to explain that where power was to be carried any considerable distance the electrical method of transmission was by far the best. It afforded an admirable means for utilising the power of water-falls at a distance from the machines to be driven. He considered that the utilisation of Niagara for supplying light and power, not only to Buffalo, but to New York itself, was a mere question of time. It was also suited to cases where the power had to be taken to places where a prime mover, such as a steam-engine, was for any reason inappropriate. An experimental instance of this was shown in an electrical winch situated in an inaccessible part of the hall, which was set in motion by a current from the lecture table, and hauled up a bundle of wooden logs. Electric power could also be applied with very special advantage wherever the piece to be moved was required to revolve very fast, and against only a slight resistance. As an example, he cited the spindles of a spinning-frame, to drive which by the present system of belts from a drum involved an enormous waste of power in overcoming useless friction. In conjunction with Professor Fleeming Jenkin, he had patented a plan of turning these, by making each of them a separate armature in a manifold electric motor, whose field magnets would reach completely round the frame. Perhaps the most fertile application of electric energy was to be looked for in the supply of small quantities of power for domestic uses, and for the convenience of small manufacturers. When once the great idea of Edison was carried out, and they had in every house and workshop the means of turning on the electric current with the same facility as they now turned on gas or water, numberless uses would be found for electric power, of which at present they could only suggest a few. Amongst these the turning of fans for ventilation would probably take a prominent and most beneficent place. Examples were then shown in which electric motors drove a sewing-machine, a fly for cooling the air of a room, and a drill for stone cutting; also two curious dental appliances, in one of which the current drove a drill for cleaning cavities in teeth, and in the other a hammer for the subsequent operation of welding gold foil. Another very promising field for the use of electric power was in driving vehicles. The lecturer explained how this had been done in tramcars, launches, and balloons by storage batteries. The other plan was to use stationary conductors with which the moving vehicle remained connected, and which brought the power from some fixed point on the line. The railways of Werner Siemens and others were referred to, and the system of electric transport (for goods traffic) was described, which has recently been invented by Professor Fleeming Jenkin under the name of Telpherage. An experiment was shown in which a small carriage was made to run up a pair of wires stretched across the hall at a steep slope, the power being supplied by a current from the lecture table. In conclusion, Professor Ewing alluded to the temporary cloud which had come over electrical matters as a natural effect of the feverish speculation of two years ago. Those who could look below the surface had not lost faith in the wonderful possibilities of this newly developed agent, and he had no hesitation in saying, although at the risk of being accused of advertising his own wares, that any young engineer who neglected to study the industrial application of electricity was barring in his own face the most inviting avenue which the profession now offered.

Lord CAMPERDOWN, in proposing a vote of thanks to the lecturer, said:—When you come to this College do not be afraid to disclose your own ignorance. It always appeared to me that one of the worst features of Englishmen or Scotchmen is that when they are in difficulty, or when they meet with a subject about which they do not know very much, they are shy to confess the truth. Take this lecture to-night. Professor Ewing said that he would not explain what a dynamo was because he assumed that we all knew about it. Well, perhaps you, ladies and gentlemen, know something about it, but I confess that I do not. My knowledge of a dynamo is of the most limited character, and if I were to attempt to explain to you the little I do know I am afraid that your knowledge would be very little increased. If I had a little more time I would respectfully ask the Professor to explain to me all the merits of a dynamo, because I am quite sure that from the great ability and great clearness with which he has expounded to us the powers of electricity he would be able to convey a very considerable amount of information to us. There is one thing to which I would ask you to attend—when you are anxious to study any subject come here and ask the Professors how to study it, because if you don't, and go on studying an unknown subject in your own way, the probability is that your own genius will likely prove a very expensive motor, and that you will spend a great deal of energy without producing any appreciable result.

THE MOST SENSITIVE GALVANOSCOPE.

By Prof. ERNST VON FLEISCHL.

THE most sensitive galvanoscope is the nerve of a frog. Its superiority over other galvanoscopes depends not so much upon its power of indicating traces of electricity as such, but rather upon its power of showing fluctuations in the strength of currents even of the feeblest intensity, if only they take place with sufficient rapidity.

As the readers of this memoir cannot be supposed to be possessed of a knowledge of anatomical and physiological details, we must first give a description of the position, of the appearance, and the general properties of the nerves and muscles of the frog. The reason why frogs are selected for these experiments is that they are easily procured in our districts; that their tissues, after the death of the frog, retain for some hours their vital properties in a degree not sensibly diminished, and lastly, that a nerve has its course in the hinder extremities of these animals, which possesses suitable dimensions for the experiment, and which is easy to prepare.

Near the lower end of the backbone of these animals the roots of the nerves for the lower extremities issue from two series of apertures in the form of fine white threads. These, after forming a plexus, unite to a thicker cylindrical stem of 1 millimetre in diameter, from which branches are given off in the shape of fine threads. These, under the microscope, appear formed of a number of extremely fine parallel fibres, each from 0·03 to 0·001 millimetre in diameter.

The roots of the nerves proceed from the backbone on each side, in two mutually distinct longitudinal series; the anterior roots, more approaching the belly of the animal, and the posterior roots turned more towards the back.

I, first preparation; N_1, nerve; F, red muscular flesh; S, sinew; E, E^1, exciting electrodes; II, second preparation; N_2, nerve; P, *f*, lower thigh and foot.

By numerous experiments which have been made on the excitability of motor-nerve fibres by electricity, it has been found that they are sensitive neither for static tensions nor for constant currents of whatever

intensity, but for fluctuations in the intensity of such currents, of whatever character.

The determining feature for the action of the fluctuations of electric currents is decidedly their abruptness. It is quite possible, *e.g.*, to introduce a current of great intensity into a nerve so gradually that the nerve, and the muscle with which it is connected, are not excited; or the current may be very gradually and slowly removed without producing any visible effect. But the sudden opening or closing, even of a minimum current, is sufficient to excite a nerve, and this sensibility of a nerve, for sudden, even though infinitesimal fluctuations of currents constitutes its peculiar value as a galvanoscope.

The fluctuations caused in the wire coils of a Bell telephone by the human voice are quite sufficient to set the nerves in a state of excitement. These fluctuations of current furnish, as is well known, a faithful image of the sound-vibrations by which the telephone is excited, and upon this the working of the instrument entirely depends. If, in a graphic representation of the movement of the air-molecules in a sound-wave, there occur portions of the curve which rise or fall with exceptional abruptness, these portions of the sound-curve correspond to abrupt positive or negative fluctuations in the currents which circulate in the telephone wire, and these fluctuations are especially well adapted to act upon the living nerve.

If the two ends of the wire of a telephone are connected by the hip-nerve of a frog, laid bare, but left

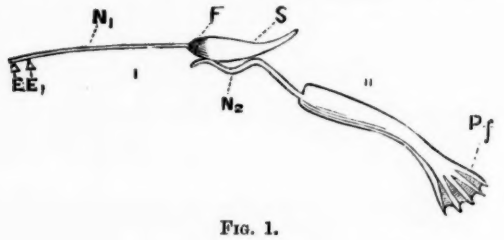


FIG. 1.

in connection with the muscle which it supplies, the latter will contract when abruptly rising or falling portions occur in the sound-waves which act upon the telephone. Professor E. du Bois Reymond has given this experiment an elegant form, utilising the different form of the curves corresponding to the sounds of different vowels in the following manner:—If the word "lie" is spoken with a moderately strong voice into a telephone connected with the prepared nerves, the muscle lies at rest, as no abrupt curves occur in this sound. But if, with a voice no louder than before, the word "jump" is spoken into the telephone the muscle is thrown into such violent contraction that, along with the nerve, it springs away from the ends of the wires to which it had been applied. (The word "jump" is the nearest approach which we can find to a monosyllabic translation of the original German word "zuck," so as to contain the same vowel. It will be better to pronounce "lie" as if written "lee," and to give "jump" with the close sound of the u, as in bull).

Another experiment in which, not merely the nerve, but the muscles themselves, are traversed by the current, is the following: place upon a large copper plate a smaller zinc plate, and upon the latter a leech. This animal soon begins to creep away from the zinc, raising the anterior part of its body and bringing down its head upon a part of the copper surface. As soon as this is touched a Daniell element is closed, the current of which passes suddenly through the body of the leech. Its muscles then contract and raise the head away from the copper plate. The interruption of the current again causes an irritation and the animal retreats still further. The same scene recurs, after a short time, with the same result, so that it appears as if the leech was held to the zinc plate by enchantment.

The nerves of the frog are so sensitive to currents that, if in preparing them, they are simultaneously touched with a steel forceps and steel scissors, and if these instruments are accidentally brought into direct metallic contact a movement is observed in the muscles, caused by the extremely feeble current proceeding from the two instruments, which, though both formed of steel, have surfaces not absolutely electromotorically equivalent. If a nerve in connection with a muscle is placed upon a piece of metal, such as a coin, and if the nerve and the coin are touched simultaneously with another piece of metal, a violent movement ensues each time on contact, but the muscle remains at rest as long as the current produced in this manner circulates constant in the nerve.

Nerves and muscles are well known to be electromotive tissues, *i.e.*, currents emanate from them which circulate both in the nerve and in the muscle from any artificial transverse section to the natural surface. In the muscle the sinew to which its fibres are attached behaves like an artificial transverse section. These currents can be easily shown by means of the sensitive galvanoscope which a nerve-muscle galvanoscope affords. In a freshly killed frog the hip nerves on one side are prepared in connection with the lower part of the thigh and the foot. The one end is cut off just where it issues from the vertebral column. On the other side of the frog the great muscle of the calf of the leg is laid bare by taking off the skin. If the former preparation is held by its lower end in the

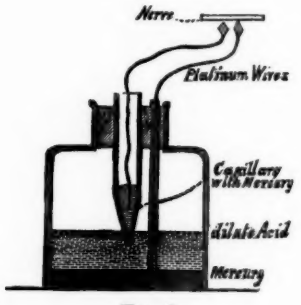


FIG. 2.

hand, and allowed to fall with the bare nerve across the muscle, so as to touch both at points of its red surface, and also at points of the white iridescent sinew, the preparation is thrown into very perceptible movement. The experiment succeeds better if a wound is made in the second muscle, and if the nerve is allowed to fall in such a manner that one part of it may come in contact with the natural surface, and another part may touch the inner surface of the wound.

An experiment which shows the extraordinary sensitiveness of the frog nerve to electrical currents, even of the lowest intensity, if they only arise or disappear with sufficient rapidity is the following: as is well known, if mercury is placed in a cylindrical tube, open above and below, but tapering downwards conically, to a capillary degree of fineness, it comes into equilibrium at a certain point. The higher the column of mercury the farther it penetrates into the tapering lower end of the tube, the smaller is the transverse section of its lower end, and the greater is the curvature of the lower surface, until at last, as the height of the mercurial column is continually increased, the mercury reaches the extremity of the tapering capillary and issues in minute drops. As long as the mercury does not flow out the column may be considered as held in equilibrium by the equality of the two forces which act upon it in opposite directions. The one force is gravitation; the opposing force is the surface-tension of the meniscus.

If the lowest part of the capillary tube below the mercury is filled with dilute sulphuric acid, and the capillary tube is plunged into a small vessel, likewise containing dilute sulphuric acid with mercury at the bottom, and if this mercury is connected with one polar wire, and the mercury in the tube with the other

polar wire, of a battery or other source of electricity, a displacement of the lower end of the mercurial column is occasioned by the action of the current.

If such a small capillary electrometer is constructed, say of a bottle 5 centimetres in height, with a little mercury poured into the bottom, and a conical glass tube as above described is passed through the neck and secured by means of a cork, so that its lower end plunges into dilute sulphuric acid, which forms a layer above the mercury, and if it is charged with mercury, and its lowest part into which the mercury does not penetrate, with dilute sulphuric acid, and if the mercury at the bottom of the bottle is connected with an insulated wire which rises up out of the bottle, whilst the mercury in the tube is connected with another wire, and the ends of these wires projecting out of the bottle, are brought in contact with the nerve of a freshly-prepared nerve and muscle, the muscle is thrown into a convulsive movement as often as the slightest agitation of the bottle occurs.

Such an agitation sets the mercury, and consequently the meniscus, which forms its lower boundary, into a slight oscillation. With every change of the form or the position of the lower meniscus, a current is produced. But in consequence of the inertia of the masses which have to be set in motion, and the extreme brevity of the time, within which the equal and opposite fluctuations of the currents pass off none of the instruments used by physicists to detect currents, are sufficiently sensitive for their indication. These feeble and transitory currents, nevertheless, excite the nerve of a frog most violently. It is merely necessary to set the bottle, as above described, upon an ordinary, firm table, and then to touch the top of the table with the finger, or to drop a small grain of shot upon it from a trifling height, in order to set the frog-nerve in movement. The author hence concludes that for very feeble currents, beginning or ceasing suddenly, the living frog-nerve is the most delicate of all galvanoscopes.—*Internat. Zeitschrift Elect. Austellung Wien.*

NOTES.

To our Readers.—It may interest those who have kindly sent subscriptions to the fund in aid of the widow and family of the late R. Werdermann to know that the amount at present contributed is £35 16s. We hope that many who have not yet sent in their donations will speedily forward whatever they can afford, for this good cause, to H. Alabaster, Gatehouse & Co. (Werdermann Fund), ELECTRICAL REVIEW office, 22, Paternoster Row.

The Jablochkoff Electric Light and Power Company.—Last week we published the directors' report, and this week we give the report of the meeting of the shareholders of this company. The figures given in the former demonstrate, we think, a most extravagant management. Were it not for this fact we should feel disposed to sympathise with the directors of the company, for they were close upon getting the lighting of the Strand District Board of Works' parishes—which would have placed the company in a splendid position, and would have enabled it to get what money it required for its work—when mysteriously, and most unfortunately for the company, the Board of Trade deemed it necessary to intervene on behalf of the Edison and Swan Companies. Thus a tremendous reverse, by no fault of its own, has almost overwhelmed a company which apparently was on the high road to success. Now, however, its future seems to us nearly hopeless, for its treasury is empty. These are the items of its *expenditure* and *assets*:—Patents and goodwill, £155,463; manufacturing premises and lighting stations, plant, machinery and fittings, £11,991; stocks on hand, &c., £8,742; preliminary expenditure, *suspense* account—brokerage on shares, £4,641; legal and parliamentary, £1,329; licenses account—fees, £100; advertising and exhibition, £716; lighting account (loss), £629; directors' fees, £2,807; salaries (office), £835; office rent, £269; salaries (manager's department), £1,754; rent and taxes of manufacturing premises, £397; printing and stationery, £208; travelling expenses, £164; cartage, £70; general expenses, £715; discounts and allowances, £29; interest, £122; less transfer fees (£11 10s.), and sundry profits (£333 2s. 10d.), together, £344 12s. 10d.; debts due to the company, £2,337; *deposits on water and gas meters*, £16; *petty cash in office*, £3 17s. 1d. The italics we use to draw attention to the last two items, and the cash, justly designated petty, we give in full, for trifles make a difference in such amounts. Now we turn to the *capital* and *liabilities*, and we find shares issued as fully paid, £100,000; shares subscribed, less calls in arrear, £76,420; amount due to bankers, £9,369; bills payable, £3,977; sundry creditors, £3,226. Thus it will be perceived there is due to the company (including deposits on gas meters, &c., and petty cash), £2,357; due by the company, £16,572.

Of course, as a going concern, the patents and goodwill may be worth something, but if the company should go into liquidation they would realise very little. The rest of the property consists of stock and plant, and for this grand result the directors take £2,806; the manager's department has absorbed £1,754, exclusive of salaries (£835), and besides rent, travelling and general expenses, &c. The directors now propose that in future they shall take no fees until the company is in a prosperous condition, but we think that had they not burdened this unhappy company with their expenses, just mentioned, in the past, it would have been rather more reconcileable with their characters as gentlemen and fair men of business. We should like to know why the manager's department is so costly; who has taken the pickings in that part of the general scramble; have any of the promoters' clique been furnished with snug nests at the expense of the shareholders? If so, what better result than that obtained could have been expected. As a general rule, as soon after the formation of a company as possible, get rid of the promoters' nominees and helps, for they know no rule of business but to get for *themselves* all they can, and, when they can. Ninety-nine times out of a hundred, we believe, they contribute largely to pull down the companies they helped to promote, and out of which they strive to grow fat. In the case of the Jablochkoff Company, more money (£20,000) is wanted on debentures of 7 per cent. But supposing this amount is obtained—it is most unlikely it will on such security—when the debts are paid, we would ask, what can be achieved with the remainder?

Electric Lighting.—Workmen are busily engaged fitting up a large number of arc and incandescent lamps at South Queensferry, North Queensferry, and the island of Inchgarvie, for Messrs. Tancred, Arrol & Company, Forth Bridge contractors. In addition to lighting the offices and workshops, the electric light is to be used on the piers and in the caissons.

The *Citizen* states that the Special Lighting Committee of the Commission of Sewers has determined upon recommending the acceptance of contracts from the Edison and Gülcher Companies for lighting the City by electricity; but there will be considerable opposition to the proposal, dictated by the belief that it would be preferable to allow the companies to operate on their own responsibility.

At Tuesday's meeting of the Commissioners of Sewers, the Special Electric Lighting Committee submitted proposals from the Edison and Gülcher Electric Light Companies in reference to the supply of electric light in the City, but it was resolved to print the committee's report, and adjourn the matter for that purpose. A motion by Mr. Innes for empowering the Streets Committee to light publicly and privately, by private contract, with the electric light companies, was withdrawn.

On Thursday, the 4th inst., upwards of 200 people assembled, by special invitation, to inspect the show-rooms at Messrs. Marsh, Jones & Cribb, of Leeds, which have for some time been fitted with the electric light. The power is obtained from the ordinary shafting used for driving the tools in the workshops. The electrical plant consists of a 100-light Ferranti dynamo machine and 60 Swan 20 candle-power lamps, fitted in most cases to the existing gas brackets, and also to one or two special electroliers. Great satisfaction was expressed with the steadiness of the lights and the effect produced, while the simplicity of the system, and the details in carrying out the installation, were much admired. The work has been done by Messrs. Kingsland & Smith, the local engineers to the Ferranti Company.

Two lectures will be delivered by Mr. W. Kingsland at the Huddersfield Exhibition, on the 17th and 31st inst., in connection with an installation of the electric light in the building. The title of the first lecture will be, "The Production of Electricity," and that of the second, "The Applications of Electricity." Both will be illustrated experimentally.

The contract for the lighting of H.M.S. *Orontes* was given to the Swan United Electric Light Company, Limited, on June 13th, 1883, on the understanding that the engines should be Gwynne's new high-speed compound direct-driving engines. The total number of lamps fitted on board, and which are to entirely replace every other kind of light, is about 385; of this number 55 are lamps of 20 C.P. each, and the remaining 330 are of 12 C.P. each, a very important feature being that the 12 C.P. lamps require the same E.M.F., and therefore are placed on the same circuit in parallel with the 20 C.P. lamps. These 12 C.P. lamps have only been recently introduced, but the results obtained with them are highly satisfactory. The lamps in each case required about 60 volts E.M.F. The majority of the fittings were the usual short serviceable brackets and pendants, but a new form of guard fitting was used in large numbers, and being of a character eminently suitable for ships' use we expect to see it very largely introduced. The back is of iron, enamelled white, of the shape of a disc, about 8 in. diameter, and the front is of strong, clear plate glass set in a brass rim, hinged at one side and locked at the other, forming a complete protection to the lamp, which can, where necessary, be made air and watertight. In the saloon, wardroom, &c., silvered ornamental fittings were used. The machines, which were in duplicate, were by Siemens Bros., of their new shunt and series wound direct current type, giving at 650 revolutions per minute from 12,800 to 13,000 volt ampères. Their working was admirable, running cool, quietly, and with only very slight sparking at the commutator. The engines, to which allusion has already been made, were by J. and H. Gwynne of Hammersmith; they are of compound type, both piston rods being connected to a common crosshead with only one connecting rod. The speed was 650 revolutions per minute, and though, owing to the very limited time at the makers' disposal, some slight additions to assist the lubrication had to be made on board, still at the time of the trials the engines upheld the reputation of Messrs. Gwynne's well-known firm, running for hours at the above-named high speed without any indications of heating. The whole of the work has been carried out in the most thorough and systematic manner, under the direction of Mr. J. F. Albright and the personal supervision of Mr. A. B. Blackburn, of the Swan United Electric Light Company, Limited, which company has at the present time a large number of ships on hand, the last order received being that for the *Clan Mathieson*, now building in Glasgow.

Under the auspices of Mr. William D. Gooch, C.E., the following systems of electric lighting are now to be seen in action at the Oldham Exhibition:—The Ball "unipolar" arc series dynamo, 7 Ball arc lamps; the Ball "unipolar" series wound in parallel, 70 incandescent; Elphinstone and Vincent, 350 Swan; Ferranti (Siemens' D 5 exciter), 348 Swan; Gramme, 5-2,000 C.P. Lea arc; Gramme, 5-2,000 C.P. Lea arc; Gramme, exciter; Gülcher, 8-2,300 C.P. arc; Gülcher, 120 Crookes'; Gülcher, compound wound, 120 Crookes'; Lumley, 7 (J. F.'s) arc; Lumley, 60 Woodhouse and Rawson; Lumley, 30 Woodhouse and Rawson.

The Worcester Town Council, last week, decided to apply for a Provisional Order, under the Electric Lighting Act, 1882, for the supply of the electric light within that town. The object of the application is, it is said, not to supply their townsmen with the improved system of lighting, but to prevent public companies from so doing.

The Hammond Electric Light Company has secured the contract for the lighting of the new shaft of the Wigan Coal and Iron Company, Wigan. The installation will be under the charge of Mr. F. D. A. Goold, the electrician to the Hammond Company, who is also at present acting as district manager.

The s.s. *Cahors* which has just been launched at Messrs. John Keys & Sons' Works, at Kirkcaldy, is to be lighted throughout by the electric light. The saloon of this ship is to be fitted in a very elaborate manner. The installation will consist of about 150 Woodhouse and Rawson incandescent lamps of ten, twenty and fifty-candle power. The contract for carrying out the electrical work has been entrusted to Messrs. Woodhouse & Rawson.

Electric Light Companies' Shares.—At the Stock and Share Auction and Advance Company's sale on Thursday, the Maxim-Weston shares realised 7s. each.

Corrections Required.—An American contemporary, in a leading article on electro-motors, says:—"The late Fleeming Jenkin stated, shortly before his death, that the reversibility of the Gramme ring was the greatest mechanical invention of modern times." Death has certainly been busy of late in the ranks of electricians, but we trust our American friend will lose no time in informing his readers that the "late Fleeming Jenkin" is still amongst the living, and that the writer of the said article most probably meant Clerk-Maxwell. An English contemporary again, states, in an obituary notice on the late C. F. Varley, that he was born in April, *1882*, and died September, 1883.

Turkey and the Eastern Telegraph Company.—The Eastern Telegraph Company, says the *Standard's* Constantinople correspondent, is so disgusted at the treatment it has received at the hands of the Turkish Government in regard to the Salonica cable, that it is understood Mr. Pender will inform the Porte that the company has resolved to lift the cable and to transfer it to Greek waters, where arrangements for relaying it have already been made.

Turkish Telegraph Service.—A telegram from Constantinople, dated October 8th, says:—On the recommendation of the Director-General of Posts and Telegraphs, a number of young men are to be sent to Paris, at the cost of the State, to study electricity. The first of these left for Marseilles last week.

New Telegraph Station.—The Eastern Telegraph Company notifies the opening for traffic of a new station at Tungchow, about twelve miles from Pekin, and the establishment of a courier service between the two places.

American Machinery.—We have received a copy of a new illustrated catalogue, containing over 200 pages, and issued by Messrs. Charles Churchhill & Co., of Finsbury, London, importers of American machinery. We have looked over the show-rooms of this firm, and can recommend anyone in search of machinery to pay a visit of inspection. Amongst the new machines are to be found grinding, wood-working, drilling, cut-off, and many other machines, together with new foot-power lathes. The list of tools is also very complete,

and the catalogue, which is said to contain the largest and most complete list of American machinery ever published in England, now illustrates the manufactures of over 130 firms.

Telegraphic.—Arrangements are said to be completed for an important series of telegraph extensions in the north of Scotland. A new news wire from London to Edinburgh, Glasgow, Dundee, and Aberdeen is in course of erection, and additional wires to these towns will be put up shortly. A new land line from Aberdeen to Buckie is to be erected, and from the latter place two cables will leave, one for Shetland and one for Wick. A new line is also spoken of between Aberdeen and Ellon.

Fire Alarms.—The fire alarms which were erected about March last throughout the borough by the National Telephone Company, Nottingham, have proved themselves in every way a great boon to the town. A large majority of the fires which have occurred since they were erected have been signalled by these alarms, thereby saving a vast amount of property, if not of life, which but for this speedy and effective means of communication must have been destroyed. In nearly every instance the brigade has left for the scene of the fire within a minute of the alarm going off. The whole of the firemen's houses are in electric communication with the Central Fire Station, and by this means the men can be summoned in the space of a few seconds. We are pleased to note the success of these apparatus.

Telegraphic and Telephonic communication.—Messrs. J. B. Saunders & Co., telegraph engineers, have just completed the erection of a private telegraph line, which connects the office of the Cwmaman Coal Company, Limited, at Cardiff and Swansea. A short loop provides communication with the collieries at Cwmaman, near Ferndale; the total length of the circuit now in use being 61 miles. This is being extended to the company's works at Llesh, and, when completed, the line will be nearly 75 miles in length, with four single needle instruments. The wire passes over high mountain land for some distance, and is, we believe, one of the longest private lines in this country. The same firm has entered into an arrangement with the Corporation of Cardiff to connect the various police and fire-brigade stations in that town, and the communication which will thus be afforded cannot fail to be of great service. The instruments to be used are Bell's telephones and Johnson's transmitters.

The Telephone at Buenos Ayres.—The directors of the River Plate Telephone Company have received advices from Buenos Ayres by the mail just to hand reporting the continued prosperity of the telephone system in that city and Montevideo, the manager advising an increase of 94 subscribers, taking 104 telephones, during the month of August.

Preston Telephonic Exchange.—At a meeting of the Fulwood Local Board last week the tender of Mr. G. Sharples for connecting the board offices and waterworks, Haighton, with the Preston Exchange was accepted; the distance to the waterworks is about four miles. At the board offices and waterworks water-level indicators will be fixed, so that the wire can be used either for telephony or water-level indicating. The offices of the engineer and the chairman of the board are also connected with the exchange. The instruments used are Crossley's transmitters and Bell telephones.

The Telephone at Windsor.—The telephone which is being constructed between Cumberland Lodge and Windsor, for the purpose of communicating with the brigades of the Royal borough in the event of a fire occurring at the residence of Princess Christian, is nearly completed. The wire is over four miles long. The telephone will not communicate with the Castle. It is simply intended for a fire alarm.

Presentation.—We understand that Mr. Eidsforth, late manager to Messrs. Paterson & Cooper, is about to start in business for himself, and that the *employés* of the firm have presented him with a handsome timepiece and testimonial as a mark of esteem.

Cable News.—The four-cored cable manufactured by Henley's Telegraph Works Company for the Danish and Swedish Governments was successfully laid between Elsinore (Denmark) and Helsinborg (Sweden) a few days ago.

Shafting at the Huddersfield Exhibition.—The whole of the shafting in motion, about 1,000 feet, at the above exhibition was lent by the Kirkstall Forge Company as part of their exhibit, and consisted of their patent rolled shafting, now so well known. It may not be out of place to name here, says the *Iron Trades Circular*, a few of the advantages this shafting has over ordinary turned shafting, viz.: The price, we understand, is about half the price of turned shafting, an advantage which in these times speaks for itself; but while there is such a gain in the cost, the rolled shafting compares most favourably with turned shafting in quality, being even 20 per cent. stronger in torsion and 33 per cent. stronger in flexion over the ordinary rolled iron, thus enabling the user to put in a smaller size—a considerable advantage. It has been thought that this rolled shafting would not run in necks without being turned, but when we inform our readers that the four lines of shafting in No. 1 shed are running at 120 revolutions a minute, and the long line in shed No. 2 at 200 revolutions a minute, and there are three counter shafts running respectively 300, 350, and 600 revolutions a minute, driving the dynamos, it will be seen that it is quite unnecessary to turn the necks. The shafting is coupled with Butler's patent frictional coupling, which has a most neat appearance, and is simplicity itself. Should there be any slight variation in diameter between two shafts of the same size, this coupling will still prove effective and run true. Messrs. Taylor & Challen, of Birmingham, have lent all the hangers, which are of their new patent adjustable type, and are considered the best of their kind, and have a very nice appearance.

Winding-up Petition.—A petition for winding-up the London and Provincial Electric Light and Power Generating Company, Limited, is to be heard before Mr. Justice Chitty on the 3rd of November.

The Vienna Electric Railway.—The financial arrangements for the electric railway at Vienna have been completed, and application has been made to the city authorities for the grant of the necessary land.

Will Atlantic Traffic Support two new Cables.—A correspondent, writing under the *nom deplume* of "Anti-Monopoly," sends us the following communication, which arrived too late for our Correspondence columns:—Having read with great interest the article in your issue of 22nd September, "Will Atlantic Traffic Support two new Cables?" and also Mr. Weaver's reply, I shall be glad if you will allow me to call attention to the following points:—With the exception of the 1869 cable, which has now been submerged fourteen years, the Anglo main cables go only from Valencia to Newfoundland, and they could now be replaced by new and improved cables for £500,000 each. The present market price is, therefore, equivalent to a very high premium on the actual value. Of course, as regards the cost to the Anglo, the case is different, since the French cable was taken over for a sum exceeding £3,400,000, an incomprehensible burden to undertake for a single cable. The Gould cables, which cost £700,000 each, are several hundred miles longer, extending from England to the North American mainland. In reference to the traffic, it must be borne in mind that the gross revenue is arrived at *after* deducting the outpays to the connecting companies; these are heavy, and remain

the same whether the tariff be 1s. or 2s., consuming, of course, with the lower tariff, a greater percentage of the income. Now these outpays will be reduced to a minimum by laying a cable direct from England to Canada and New York.

It should be remarked that when the Anglo adopted the 1s. rate, it was as a "fighting" and not as a permanent tariff; but, during its operation, senders of messages complained greatly about the delay, showing that the *cables laid were not enough to carry the traffic at* 1*s. per word*, and throughout that time the Pouyer-Quertier Company was able to maintain the 2s. rate. Moreover, the traffic has considerably increased, owing to messages for South America being now forwarded *via* New York. It is obviously unfair to place new cables in the same category with those which have been submerged from eight to 14 years, and there are four which have been laid so long. Mr. Weaver, however, is good enough to apportion to the new company only $\frac{1}{5}$th of the total receipts, without allowing for special efforts to obtain a larger share, to which its new cables, of greater capacity, would entitle it; nor does he give credit for the smaller outpays to connecting companies. From the published reports of the various companies, the revenue appears to be upwards of £1,000,000 per annum; of this, the new company's proportion, even on Mr. Weaver's assumption, would be £200,000, which is amply sufficient to pay a dividend of over 7½ per cent., and leave enough for working expenses and reserve fund. I hope on a future occasion to consider the question of a reduced tariff and its effects.

CITY NOTES, REPORTS, MEETINGS, &c.

The Jablochkoff Electric Light and Power Company, Limited.

THE ordinary annual general meeting of the shareholders was held at the Cannon Street Hotel, on Thursday of last week, Mr. James Wilson, the chairman, presiding.

Mr. Francis R. Reeves, the Secretary and General Manager, read the notice convening the meeting, and the report and accounts were taken as read.

The Chairman said: Gentlemen, previous to moving that the report and accounts be received and adopted, I will make a very few remarks upon the business of the company. The report, as you see, states pretty fully what we have been doing since the company was launched fifteen months ago. It tells you that the Embankment light has been proceeding from the time we took it over, but the contract was made at an unfortunate time, and it has proved a losing concern, as you all know. But it forms a capital advertisement for our business. It was supposed it would at least pay for working expenses, but it does not. There was an annual loss upon it of £700 a year when we took it over, but it has been reduced to about £500. Soon after the formation of the company, and finding the time for forming subsidiary companies had passed for the moment, we turned our attention to the actual establishment of a factory, and to carrying out installations throughout the whole country and abroad. You will recollect that the purchase of our patent is not merely for the metropolis, or for England, but it is for the whole of the British Isles and Colonies, with the exception of India, therefore forming a large field for our enterprise when we once get into working order. At the time of the contract we had to purchase all our candles, which are the backbone and foundation of the company. We had to purchase them in Paris, but after that we acquired machinery which had been constructed in Paris for this purpose, and also Frenchmen who were accustomed to make the candles, and we took premises, and now we manufacture them for ourselves, and that forms an excellent source of profit. We are making them better and cheaper than supplied by the French company. The works are well worth a visit, and any shareholder can obtain an order from the secretary, and you will also see that the business of the company is placed upon an established footing, for the manufacture of the Jablochkoff candles, of which we are making thousands upon thousands at a profit. We have electricians to carry on instalments not only in London, such as the Covent Garden Theatre, the Avenue Theatre, and other places, but also in the provinces. In the first instance, there was not much profit attached to these; but now having the works completed, and the men under control, we are enabled to work at a decrease of expenditure and an increase of profit in the undertaking. We are also working at Belvedere Works, Lambeth, which are supplied by an engine which was taken over at the time of the formation of the company. The wires are carried across Waterloo Bridge, and supply the lights for the Covent Garden Theatre and the Gaiety Restaurant. We had hopes that this engine would have done much work by this time, but we have been, in a measure, paralysed by the "powers which be;" we hope something may come in the future, although we have to rest a short time before we take any steps. I refer to the course adopted by the Board of Trade as to the various parishes, and their advice as to what they are to do in adopting the electric light. They seemed to say to the parishes—"It is useless to shut your eyes as to the importance of this future light, and however great your interest, individually or collectively, may be in gas, we are determined that you shall not stand still, and that you shall have this light; therefore we tell you you may adopt any system you please; we leave you any system you like; adopt it yourselves; we will enable you to grant licenses for seven years to any parties you please, but should you not do so, and in your apathy or ignorance refrain from taking such a step, we will step in and grant provisional orders to whomsoever we like for twenty-one years," which really means in perpetuity. Well, we succeeded against great opposition in actually obtaining from the Strand Board of Works licenses for the whole of their large district, which comprises six parishes, and with these in our hand we certainly thought we had succeeded in establishing in the largest district in the metropolis a great and important business, which would compel us in that one parish to spend from £70,000 to £80,000 in plant and installations. We also obtained from the Marylebone vestry licenses, where also an equal amount had to be spent, and having these in hand, and seeing that our capital was small, one-third not having been yet issued, I obtained an introduction to a member of one of the leading houses in the city, and he said to me, in the presence of our secretary: "Mr. Wilson, if you get those licenses confirmed by the Board of Trade we will find you as much money as ever you like." However, in the result I may tell you, as no doubt you all know, the Board of Trade, in opposition to the Strand Board, have granted to the Edison and Swan Company Provisional Orders for the whole of those six parishes. We contested that; we had Parliamentary agents, and we contested it both in the House of Lords and in the House of Commons, and the House of Lords, I may tell you, from what I have heard, were actually in our favour, but the Board of Trade officials seemed to have sided most strongly with the Edison and Swan Company, and overrode altogether the licenses granted by the parishes to us against the wishes of the vestries, and they gave to the Edison and Swan Company the Provisional Orders for 21 years for the whole of those six parishes. We do not know at present what to do in the matter; but supposing we can go on, and have sufficient funds, we shall be enabled to make such arrangements as are necessary to be made in your interests. We are sure, and so are the parishes, that our arc light is the one that will outlive all the others. We have shown at the various exhibitions—at the Fisheries Exhibition, for example—that we have a cheap and economical light, and it is placed in competition with lights which give 3,000 candle-power, and which take, in proportion, a much greater horse-power to work it, and therefore greater expense. Ours is an economical light, sufficient for all purposes, and has shown itself to the world as more efficient than any brought forward. I have seen it in Paris; it is the only light which is used there. The French have had great opportunities of seeing the light, and they use it in the streets and in the magazins. In the Magazin Printemps they have it, and the Parc de Monceau is lighted by the electric light, and the authorities have made a contract with the French company, paying double what they did before. The report shows the number of works we have carried out. It would not be in the interests of the company to enumerate those installations which we are asked at present to do. We have many inquiries, and we have more work offered than we can do if we had four or five times our present capital. With respect to subsidiary companies, I mentioned that soon after the formation of the company the time passed at which they could be formed; but at the present time arrangements are being carried out for the formation of a Scotch company. We have lighted up the Lyceum Theatre in Edinburgh, and also a theatre at Glasgow, and the Scotch people seem very anxious to carry this thing through. With respect to the financial position of the company, unfortunately the balance-sheet shows that too clearly, but it might have been made to show better had some profits which we have really made been carried in. The profits shown here are £332 2s. 11d., but that, in our opinion, ought to have been about £900 more. We have done about £7,000 worth of work. The accounts have been placed in the hands of Mr. Mackay, the auditor, who has also been acting for us as accountant in making up our books. We had a clerk in whom we lost confidence, and we got rid of him, and placed our books in the hands of Mr. Mackay, who has thoroughly gone into every account, even to the smallest item. I think this profit should have been shown £1,244 12s. 10d. instead of the £333, at which it is put down, as we have earned it and made it. I do not think there is anything more to say, except to call attention to the last clause but one, namely, that we want more money to carry on the undertaking. We have manufactories, we have workmen to pay every week, in order to create a profit for this company, and the only way we see in which we can advise you to increase the finances of the company is to propose that you should take up some of the debentures, which will be a first charge, and pay interest of seven per cent. I may tell you (as you may know) that by the articles of association the board of directors consists of eight gentlemen. We have arranged that four of those gentlemen shall retire, and that four gentlemen elected from the body of the shareholders shall join those who remain. Then (and this will show our faith in the company), we propose to alter clause 66

of the articles of association, so that it reads as follows:—"That no one holding less than 200 shares in the company, upon which the calls for the time being shall have been paid, shall be eligible as a director, and this shall apply to the present as well as to future directors." (Cheers.) When we joined the company we found that the directors had to have a qualification of 25 shares; we took them, but we propose to alter that, and to make it 200 instead of 25. We also propose that in future the directors shall take no fees until the company is in a prosperous condition. (Cheers.) We feel we have done our best for the company; we have had a difficult task to perform; we have had to establish manufacturing works. It is like a mill-owner who has had to begin and construct the whole of his works from the foundation upwards. We have had to do all that, and we have made an established business; and I should regret very much if the shareholders do not think fit to provide funds to carry this undertaking on energetically, for I am quite sure it will be a highly prosperous and successful undertaking. We also propose to reduce our establishment charges as much as possible, consistent with the actual progress of the company.

A Shareholder: I thought the establishment charges were closed.

The Chairman; I mean the administration charges for clerks and so on. As far as we are concerned, I know I can speak sincerely for myself, and I can speak for my co-directors, that, although we have taken our fees as specified by the articles of association, we have worked hard for them. I know for myself that every farthing I have had I deserve, and I may say my brother directors have done the same. There is nothing in this life so successful as success, and if we had had the licenses confirmed by the Board of Trade for the Strand district, we should have been in a very different position to what we are now. But circumstances and fate have been against us so far. But we stand before you with a well-established business at this moment, and the only difficulty at present is want of funds to carry it out. (Hear, hear.) With these remarks I beg to move the adoption of the report and balance-sheet, and I shall be happy to answer any question which any shareholder may wish to put.

Col. Keate seconded the motion.

A long discussion ensued chiefly on matters of detail, and some of the shareholders criticised somewhat adversely the management of the company, and questioned whether the business was so sound as represented in the report. On the other hand, several influential shareholders stated that they had gone carefully through the accounts, had examined the works, and found that the company was in a thoroughly solvent condition, that the prospects of a profitable business were most encouraging, and that the arc light of this company is undoubtedly the best before the public.

Mr. Meyers, of Messrs. Samuel Brothers, of Ludgate Hill, stated that his firm has used the light for upwards of four years, during which time he has never had occasion to call in an electrician, and that the whole apparatus, gas engine, dynamos, &c., were entirely managed by the head porter.

The resolution for the adoption of the report was then put and declared carried.

Mr. Mackay was then re-elected auditor.

With the full consent of the board a committee of five gentlemen was appointed to confer with the board as to the nomination of four gentlemen to join the board in the place of those retiring.

A vote of thanks was then passed to the chairman. and the meeting broke up.

The Eastern Telegraph Company, Limited.—This company notifies that the 6 per cent. debentures of the company falling due on the 15th October, being Nos. 1 to 2,320 inclusive, will be paid off on and after that date by the bankers of the company, Messrs. Glyn, Mills, Currie & Co., 67, Lombard Street, London.

The Anglo-American Telegraph Company, Limited.—The directors, after placing the quarterly sum of £37,500 to the Renewal Fund, propose an interim dividend for the quarter ending September 30th of 15s. per cent. on the ordinary and 30s. per cent. on the preferred stocks, both free of income-tax, payable on November 1st to the stockholders registered on the books on September 30th. On the Stock Exchange on Friday of last week, the stocks of this company were lower on rumours as to the arrangements being made for bringing out the new cable company.

The Submarine Cables Trust Company, Limited.—Notice is given that the coupons of the Submarine Cables Trust, due on the 15th inst., will be paid on and after that date by Messrs. Glyn, Mills & Co., at 67, Lombard Street, E.C.

The Brazilian Submarine Telegraph Company, Limited.—The directors recommend the declaration of a final dividend of 3s. per share, making, with previous interim payments, 6 per cent. per annum on the shares for the year ending June 30th last, carrying forward a balance of £19,434. In view of the necessity for a large expenditure in repairs and duplicating the Madeira-St. Vincent and St. Vincent-Pernambuco sections, the directors think it unadvisable to make any distribution of profits on this occasion beyond the 6 per cent. above mentioned.

The West India and Panama Telegraph Company, Limited.—The directors have resolved, after placing £20,000 to reserve, to recommend a dividend of 3s. per share on account of arrears of dividend on the First Preference shares.

Reuter's Telegram Company, Limited.—The directors have declared an interim dividend at the rate of 5 per cent. per annum for the half-year ending the 30th June last, payable on the 13th inst.

The Eastern Extension, Australasia and China Telegraph Company, Limited.—The accounts for the half-year ended 30th June show a net profit of £107,356. After providing for two quarterly interim dividends, and a bonus of 1s. per share, making together 3 per cent. for the half-year, there remains a balance of £32,356 to be carried forward.

The Indo-European Telegraph Company, Limited.—The Board has declared an interim dividend for the half-year ending June 30th last at the rate of 5 per cent. per annum, free of income-tax.

The Gulcher Electric Light and Power Company, Limited.—The registered offices of this company have been removed from Battersea Foundry, S.W., to 4, Coleman Street, Bank, E.C.

The Direct United States Cable Company, Limited.—This company notifies that the half-yearly interest on their Six per Cent. Debenture Loan will be paid, on and after the 15th inst., at the Consolidated Bank, Limited, Threadneedle Street.

LATEST QUOTATIONS.

Authorised Issue.	Share.	Name.	Paid.	Closing Quotams, Oct. 10.	Business Done.
		ELECTRIC LIGHT.			
40,000	10	Anglo-American Brush Co.	8	2½-2¾	2¾-¼a.
		Do. Do.	10	4 - 5	
30,000	5	Australasian E. L., Power & Storage Co.	3	¼- ⅜	
24,900	10	British Insulite Co., Ld., "A" Shares..	5	1 - 2	1-1⅛m.
30,000	5	Brush Elec. Lt. & Power Co. (Scotland)	2½	⅜- ½	
25,000	5	Gt. Western Electric Light & Power Co.	2½	⅜- ½	
24,980	5	Hammond Elec. Lt. & Power Sply. Co.	3½	2 - 2½	2-2⅛-2¼m.
40,000	5	Indian & Ori. Electl. Storage Wks. Co.	2	..	
173,500	1	Maxim-Weston Elec. Lt. & Power Co..	1	⅛- ⅛	⅛m.
..	..	Metrop. Brush Electric Lt. & Power Co.	3	..	
40,000	5	Pilsen-Joel & Gen. Elec. Lt. Co.	2½	..	
..	..	S. African Brush Elec. Lt. & Power Co.	2½	..	
100,000	5	Swan United Electric Light Co., Ld.	2½	1¾- 2	
		TELEGRAPHS.			
2,116,400*l.*	Stk.	Anglo-American, Limited	100	45½- 46½	
2,441,800*l.*	Stk.	Do. Pref. } Def. receiving no div. until	100	76½- 77½	77m.
2,441,800*l.*	Stk.	Do. Def. } 6 p. c. paid to Pref.	100	15½- 16½	
150,000	10	Brazilian Submarine, Limited	10	10¾- 10⅞	10⅞-⅛m-10⅞-⅛a.
16,000	10	Cuba, Limited	10	10½- 11	
6,000	10	Do. 10 per cent. Preference ..	10	17 - 18	
13,000	10	Direct Spanish, Limited	9	5½- 5⅝	
6,000	10	Do. 10 per cent. Preference ..	10	15½- 16½	
65,000	20	Direct United States Cable, Ld., 1877 ..	20	11¾- 12⅛	12⅛m.
100,000*l.*	100	Do. 6 per cent. Deb., repayable 1884	100	101 -102	
380,000	10	Eastern, Limited	10	10⅞- 11⅛	10⅞-11-⅛m-11a.
70,000	10	Do. 6 per cent. Preference	10	12¾- 13½	13⅛a.
232,000*l.*	100	Do. 6 do. Debs., repayable Oct. 1883	100	100-102	
200,000*l.*	100	Do. 5 do. do. Aug. 1887	100	101-103	
200,000*l.*	100	Do. 5 do. do. Aug. 1899	100	103-107	
199,750	10	Eastern Exten., Australasia & China, L.	10	11¼- 11⅜	11⅛m-11⅜.
320,000	100	Do. 6 p. c. Debs., repayable Feb. 1891	100	106- 109	
500,000	100	Do. 5 p. c. (Aus. Gov. Sub.) Deb. 1900	100	102- 106	
140,000	100	Do. do. reg., repayable 1900..	100	102- 106	
100,000*l.*	100	Do. 5 per cent. Debenture, 1890	100	102- 105	
254,300*l.*	100	Eastern & South African, Ld., 5 p. c. } Mort. Deb. Rg. redeemable 1 Jan. 1900 }	100	102- 105	
345,700*l.*	100	Do. do. do. To Bearer..	100	102- 105	
22,050	10	German Union Telegraph & Trust, Ld.	10	10 - 10½	
168,300	10	Globe Telegraph & Trust, Ld.	10	7⅞- 7¾	7⅞m.
163,209	10	Do. 6 per cent. Preference	10	12⅞- 13	13m.
125,000	10	Great Northern	10	12¾- 13¼	
100,000*l.*	100	Do. 5 per cent. Debentures ..	100	100 -102	
300,000	100	Do. 5 per cent. Debentures ..	100	100 -102	
31,200	10	India-Rubber, Gutta-Percha, & Tel. Wks.	10	30½- 31½	31m.
100,000	100	Do. 6 per cent. Debs., 1886	100	102-105	
17,000	25	Indo-European, Limited	25	31½- 32½	32m.
38,148	10	London Platino-Brazilian, Limited	10	3½- 4	
12,000	10	Mediterranean Extension, Limited	10	1½- 2	
8,200	10	Do. 8 per cent. Preference	10	2 - 4	
9,000	8	Reuter's, Limited	8	8⅞- 9½	9m.
280,000	Stk.	Submarine	100	215 -225	
58,225	1	Do. Scrip	1	1⅛- 2⅛	
4,200	Cert.	Submarine Cables Trust	100	104 -107	
37,350	12	Telegraph Construction and Mainten.	12	33½- 34½	33¾m-34m.
150,000	100	Do. 6 per cent. Bonds, 1884 ..	100	101 -103	
186,750	5	Do. 2nd Bonus Trust Cert. ..	2½	1⅛- 1⅞	
30,000	10	West Coast of America, Limited	10	4⅞- 5⅛	
150,000	100	Do. 8 per cent. Debs.	100	105 -108	
69,910	20	Western and Brazilian, Limited ..	15	5⅜- 5⅝	
		Do. Preferred	7½	4¾- 5	
		Do. Deferred	7½	⅞- 1⅛	
200,000*l.*	100	Do. 6 p. c. Debs. "A" 1910 ..	100	102 -106	
2,500	100	Do. 6 p. c. Mort. Deb. B. '80, red. Feb. 1910	100	95 - 98	
1,500	$1,000	Western Union 7 p. c. 1 Mort. (Bg.) Bds.	$1,000	122 -124	
1,030,000*l.*	100	Do. 6 per cent. Sterling Bonds	100	100 -103	
88,321	10	West India and Panama, Limited	10	¾- 1	¾-1-⅛m.
34,563	10	Do. 6 per cent. 1st Preference	10	6¼- 6⅝	
4,609	10	Do. 6 do. 2nd do. ..	10	4¼- 5¼	
		TELEPHONES.			
154,165	1	Con. Tele. & Mainten., L., Nos. to 154,165	1	⅛- ⅜	
200,000	1	Oriental Tele. Co., Nos. 80.001 to 300,000	¼	⅛- ⅛	
100,000	5	United Telephone Co.	5	8½- 8¾	

TRAFFIC RECEIPTS.

The Eastern Telegraph Company, Limited. The estimated receipts for the month of September amounted to £42,778, and to £37,271 in the corresponding period of 1882.

The Great Northern Telegraph Company. The returns for September show a total of £23,640. From January 1st to September 30th, the receipts reached £191,680, against £182,294 and £180,279 in the corresponding periods of 1882 and 1881 respectively.

NEW PATENTS—1883.

4710. "Telephonic and telegraphic apparatus." A. R. SHAW. Dated October 3.

4726. "Cables for transmitting electric currents, more particularly applicable as ærial telephone conductors." F. C. GUILLEAUME. Dated October 4.

4728. "Construction of galvanic batteries." A. C. HENDERSON. Dated October 4.

4769. "Telegraph cables." F. C. LOE. Dated October 8.

4778. "Preventing or neutralising earth or foreign currents in electric telegraph wires and apparatus therefor." J. W. FLETCHER. Dated October 9.

4780. "Dynamo or magneto-electric generators." H. B. FORD. Dated October 9.

4781. "Conductors of electricity." J. G. PARKER. Dated October 9.

4787. "Electrical, synchronous, telegraphic and other systems." S. PITT. (Communicated by P. B. Delany.) Dated October 9.

4788. "Telegraphy." S. PITT. (Communicated by P. S. Delany.) Dated October 9.

4800. "Electro-magnets." J. H. JOHNSON. (Communicated by E. F. Recordon.) Dated October 9.

4801. "Forming or preparing of elements for use in secondary batteries." H. J. HADDAN. (Communicated by C. F. Brush.) Dated October 9.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1883.

156 "Apparatus for controlling, indicating, and arresting the flow of electric current." W. M. MORDEY. Dated January 10. 6d. Relates more particularly to controlling the current passing from a source of electricity, such as a dynamo machine, into accumulators or secondary batteries, into electro depositing apparatus, and into systems of electric mains and the like. It is also, in part, applicable to switches and other instruments whereby an electric circuit may be broken.

179. "Telephonic transmitters." H. ALABASTER and T. E. GATEHOUSE. Dated January 11. 6d. Relates to the construction of instruments, to receive vocal or other acoustic impulses, for transmission in a telephonic circuit, technically known as "transmitters," and is designed to effect louder and clearer transmitted articulation, by means of the said "transmitter;" and, by the absence of a fixed vibrating diaphragm or tympan, to afford an increased sensitiveness, and to avoid the creation of any continued dominant tone, or "buzz," from loud speaking during the use of the instrument. The invention consists of the combination with one another, of a bridge, with accurately plane and smooth under surface, resting upon, and forming electrical contact between, two electrodes, also with accurately plane and smooth upper surfaces, all preferably of carbon, the said bridge receiving, direct, the acoustic impulses, through a confined passage, such as a speaking tube.

184. "Dynamo or magneto-electric machines, &c." H. H. LAKE. (Communicated from abroad by C. L. R. E. Menges, of the Hague, Holland.) Dated January 11. 1s. Relates to dynamo or magneto-electric machines, and consists in an improved magnet and armature, employed either together or separately, in combination with other suitable magnets or armatures. The said invention also comprises the use of permanent magnets instead of electro-magnets. The improved machines are applicable for all purposes for which such machines are usually employed, and consequently for the production of motive power by means of an electric current.

187. "Modes of producing electric light." J. A. BRIGGS. Dated January 12. 2d. The inventor employs the focus of the cathodic rays, formed by electric discharge in high vacuo, as a source of intense heat to render refractory bodies (*i.e.*, bodies which do not fuse except at very high temperatures) incandescent. (*Provisional only.*)

217. "Working and regulating secondary batteries, &c." J. S. SELLON. Dated January 13. 8d. Relates, firstly, to secondary batteries or electrical accumulators so constructed that the cells shall be practically or sufficiently gas or air tight, that the pressure of gas or gases resulting from full or overcharging can or may be utilised to work a lever valve or pressure box or bag, or compressible, expansible, or moveable receptacle of any suitable kind, or a receptacle containing any substance or material which can be compressed, moved, or expanded by pressure, or by the action of the gases electrically, chemically, or mechanically, or any suitable combination in such a manner that each cell to which such arrangement is attached, or each set or sets of cells in connection therewith, which can or may be so controlled may be cut out of circuit of the charging lead or main, and fall in again, as required, by means of a contact shunt valve, lever, or suitable mechanism which can be actuated by such pressure, whether brought about mechanically, electrically, or chemically. The invention relates, further, to the employment in connection with secondary batteries of an electro-magnetic or suitably constructed switch which can be actuated by the outgoing current, when such current falls below a given electromotive force, so as to cause the magnet or magnets to switch in one or more accumulators, from time to time, as may be required for the purpose of maintaining a constant or practically constant electromotive force. The invention further has for its object, in charging secondary batteries or electrical accumulators, to prevent the return or reversal of the current by causing such current to pass round an electro-magnet, between the poles of which a magnet is so suspended or arranged as to be free to move the said magnet, being placed in such a manner that any reversal of current will cause it to make contact, and shunt or connect a portion of the current to an electro-magnet, which magnet allows or causes the switch, constructed with a spring or other suitable arrangement, to shut off, thereby preventing the return of the current to the dynamo. The invention, further, relates to the employment of "series" dynamo machines for charging accumulators. The invention has, further, for its object to enable the attendant to recognise at once whether a cell is short circuited. A further portion of the invention relates to circuits in which there is a combination of arc or other lamps and accumulators. The invention has, further, for its object to enable the same dynamo machine to supply various strengths of current.

243. "Galvanic batteries." H. H. LAKE. (Communicated from abroad by A. Skene, of Vienna). Dated January 15. 6d. The object of this invention is the production of galvanic batteries or cells which shall have a continuous and uniform action, and supply a large amount of electricity at a small cost. When a copper plate is dipped in a weak solution of sulphuric acid, and then exposed for a time to the action of the atmosphere, and again plunged in a weak solution of sulphuric acid in which is placed an amalgamated zinc plate, an electric current is developed, which, although very strong to begin with, gets much weaker after a time, notwithstanding the increased consumption of copper. If, however, the copper plate is taken out of the solution after a few moments and allowed to remain exposed to the air for a short time, and again placed in the solution, a very strong current will be generated, while the quantity of copper consumed will be very small. According to the present invention the copper plate is alternately lifted out and replaced in the solution, so that it comes successively in contact with the solution and with the air. For this purpose the inventor arranges the copper plate or plates upon an axis of rotation or oscillation in a zinc trough filled with the said solution, so that only about one-half of the disc is immersed in the fluid, while the other half is exposed to the air.

275. "Applying alternating electric currents to the production of light." A. MUIRHEAD. Dated January 17. 2d. The inventor interposes in the system composed of the dynamo machine, conductors and lamps, a condenser which may either be placed in the main circuit or in a derived circuit connected with two points of the main circuit. (*Provisional only.*)

282. "Primary electric or voltaic batteries." M. R. WARD. Dated Jan. 17. 2d. The main object of this invention is to provide means for keeping up the supply of liquids used in what are known as primary electric or voltaic batteries. According to the invention, reservoirs are placed in any convenient position relatively to the battery, and an arrangement of pipes and valves, or taps, so arranged that fresh liquid can be turned into the battery when required, and also the waste liquid drawn off. (*Provisional only.*)

285. "Electric lamps." J. UNGER. Dated Jan. 17. 2d. According to this invention, the improved lamps are constructed with a brass tube containing a liquid, in which liquid is immersed a float of less specific gravity than the liquid. A carbon rod is supported by this float, so as to be continually pressed upwards against an iron cylinder, being guided by two copper guides, screwed to the brass tube. The liquid contained in the brass tube is of such a nature as to increase the illuminating capacity of the carbon, such, for example, as a solution of chloride of zinc in water; this liquid being absorbed by the carbon, the water evaporates, and the chloride of zinc remains in the pores of the carbon, whereby the lighting power of the latter is greatly increased. (*Provisional only.*)

287. "Accumulators for storing electrical energy, &c." H. H. LAKE. (Communicated from abroad by Nicolas de Kabath, of Paris, France.) Dated Jan. 17. 4d. Relates to electric accumulators, in which lead plates are employed, and to devices for facilitating the removal or transport thereof. (*Provisional only.*)

288. "Apparatus for regulating or controlling electric currents." H. H. LAKE. (A communication from abroad by Nicolas de Kabath, of Paris.) Dated Jan. 17. 10d. Relates to apparatus designed to regulate or control electric currents, and maintain the same constant. This apparatus is arranged in such a manner that it can be applied to any source of electricity, whatever may be the purpose for which the electric current is employed. (*Provisional only.*)

295. "Treating yarns and covering wires for telegraphic, telephonic, or electric lighting, &c." W. T. GLOVER and G. F. JAMES. Dated Jan. 18. 6d. The object of the first part of this invention is to cover bare wire or wires which have been previously covered with gutta-percha, india-rubber, &c., with a furthering covering of yarns which, in accordance with this invention, have been previously immersed in or passed through heated ozokerit, paraffin, or other preserving and insulating compound requiring heat in its application. The invention further relates to improvements in the spindles, which are by preference used for braiding the improved yarn as aforesaid upon the bare or covered wire, and which improvements are equally applicable to braiding spindles generally.

306. "Electric signs or apparatus for illuminating and signalling purposes." H. V. WEYDE. Dated Jan. 18. 2d. Relates to improvements in the construction and arrangement of electric incandescence lamps, and in the composition therewith of letters, words, figures, signals, and designs for the purposes of publicity, signalling, and illumination. (*Provisional protection not allowed.*)

308. "Electrical signalling apparatus for use on railways." W. WALKER. (Communicated from abroad by C. D. Tisdale, of America.) Dated Jan. 18. 4d. Relates to electrical signalling apparatus for use on railways. It consists mainly in employing any auxiliary magnet and circuit properly arranged to draw an armature into the range of its main controlling magnet, instead of employing mechanical means to effect this operation, as is usually the case. (*Provisional only.*)

316. "Dynamo-electric machines." F. H. RELPH. (A communication from abroad by J. Olmstead, of America.) Dated Jan. 19. 2d. Relates to improvements in magneto and dynamo electric machines, whereby a very high electromotive force is obtained with machines of great compactness, lightness, and durability. (*Provisional only.*)

317. "Secondary or storage batteries." H. J. HADDAN. (A communication from abroad by Dr. E. Boettcher, of Leipzic.) Dated Jan. 19. 2d. Has for its object to construct a powerful storage battery having but little weight. For this purpose the inventor decomposes a solution of pure sulphate of zinc by the current of a dynamo machine or other suitable source, and thereby causes zinc to be deposited on an electrode of thin and pure sheet-zinc or sheet-lead. The other electrode is a thin sheet of lead, covered on both sides with porous lead, produced by the electrolytical reduction of an oxide of lead (litharge).

321. "Switch for increasing or diminishing the strength of current in electric lighting apparatus." F. MORI. Dated January 19. 4d. Relates to apparatus for varying the strength of current in electric lighting apparatus so as to produce different degrees of illumination. For the purpose of diminishing the strength of the current transmitted to the lamps the inventor employs a series of resistance coils, any or all of which may be introduced into the main circuit at pleasure, and thereby produce as many different degrees of light as there are coils employed.

348. "Voltaic batteries." R. H. COURTENAY. Dated Jan. 20. 2d. In the first part of the said invention the inventor employs metallic and absorbent conductors in lieu of the ordinary porous cells. The second part of the said invention consists in the employment of three or more elements, the first being absolutely negative, the second partially negative, and the third absolutely positive—for instance—the inventor takes one or more plates of carbon and places them in a grooved box or other arrangement and thoroughly insulates the solution in which the carbon is placed, and connect with the plate of carbon a plate of nickel or other metal electrode, positive to carbon but negative to zinc, the metal connected to the carbon is thoroughly isolated from the solution containing the carbon and zinc, and the solution can be evaporated, and the salts of the metals isolated, collected for sale or use (*provisional only*).

349. "Telephonic apparatus." C. A. TESKE. Dated Jan. 22. 6d. Consists of an instrument where transmitter, receiver, bell, push, switch, induction coil, and relay are combined in one, so that the whole system may be handed about from ear to mouth and back to the desk, or *vice versa*.

357. "Dynamo or magneto-electric machines." H. H. LAKE. (Communicated from abroad by H. R. Boissier, of America). Dated Jan. 22. 6d. Relates particularly, first: to the commutator brushes and brush-holders, and second, to a shunt circuit around the armature or inductive portion of the generator.

361. "Electric lamps or lighting apparatus." H. H. LAKE. (Communicated from abroad by H. R. Boissier, of America). Dated Jan. 22. 6d. Relates to arc lamps or lights. The object of this invention is—first, to provide an effective, simple and reliable carbon feed; and, second, to provide an effective, simple, and reliable "cut out," or means for shunting the current around any lamp of a system upon its failure or cessation of light giving.

371. "Electric lamps." A. E. SWONNIKOFF. Dated Jan. 23. 6d. Relates to a method and apparatus for regulating the distance of the carbons of arc electric lamps.

397. "Electric lighting." J. COOPER. Dated Jan. 24. 2d. The inventor constructs the resisting material, which becomes incandescent, and which furnishes the light, of a tube or tubes of alumina, which is filled with a pencil of suitable carbon. This carbon is closely packed into and entirely fills the tube. (*Provisional only.*)

400. "Electric generators and motors." W. M. MORDEY. Dated Jan. 24. 6d. The object of the invention is to simplify the collection of the current by connecting the equipotential points of the armature with one another by means of conductors, such as metallic wires, plates, rings, bars, or their equivalents; such connections being made either between the conductors which connect the armature and the commutator, or between the commutator segments or plates themselves.

405. "Insulators for telegraph posts, &c." P. R. DE FAUCHEUX D'HUMY. Dated Jan. 25. 6d. Has for its object improvements in insulators for telegraph posts or other supports, whereby a more efficient insulation is obtained, and provision afforded for any required number of wires at a comparatively small expense.

454. "Circuits and apparatus for electric temperature and pressure indicators." W. P. THOMPSON. Dated Jan. 27. 10d. Relates to certain improved methods and apparatus for indicating at any required station, variations in temperature or in the pressure exerted by fluids, gases, or volatile substances at distant points. The invention comprises an organisation of apparatus located at the point where the variations which are to be indicated occur, and adapted to transmit through suitable conductors. successive electric impulses of a character and frequency dependent upon the nature and extent of the variations occurring in the temperature or pressure. At the receiving station is placed an organisation of apparatus actuated by the successive impulses transmitted through the main line conductors to indicate the frequency and extent of the variations.

460. "Telephones." T. J. HANDFORD. Dated Jan. 27. 2d. The inventor employs as a receiver a solenoid or sucking magnet (that is to say, a coil having a movable core) connected up in the circuit with a battery. The core of the solenoid or sucking magnet is attached at one end to a diaphragm—say, for example, at or about the centre thereof, the said diaphragm being by preference secured at its edges, and the other end of the core is acted upon by a spring or equivalent device. (*Provisional only.*)

482. "Construction of a secondary battery or accumulator of electricity." A. L. NOLF. Dated Jan. 29. 2d. The electrode, which is to collect the greatest possible amount of hydrogen, is a sponge of metallic lead, reduced galvanically, having a bright crystalline appearance, all the pores of which may be easily and uniformly permeated by the liquid and by the gases, no matter what may be the thickness of the layer. The other electrode is formed of a layer or thickness of pure minium, or it may be mixed either with 50 per cent. in volume of spongy lead, or with 10 per cent. in volume of hard-wood charcoal coarsely pulverised. (*Provisional only.*)

CORRESPONDENCE.

Patents for Telephones.

Your contributor, "Das Telephon," may "be surprised to learn" that Dr. Ferguson's work on "Electricity" was actually "put in" for consideration in the telephone "case" at Edinburgh, a copy being furnished, on solicitation, by the author himself for the judge. And if its testimony as to the Reis telephone transmitter and receiver, along with other similar evidence, was ineffective, not only at Edinburgh but at London as well, there may have been several reasons operative. There was not then to hand what is now deemed a grand totality of testimony, fully establishing the position of Reis as the true inventor of the telephone in all its fulness of essential or useful principles. This is now happily and fully set forth in the recent work entitled "Philipp Reis, Inventor of the Telephone,"* and the author is well worthy of praise for his able and valuable treatise. This is not the occasion to set forth the valuable conclusions of this work, but it may here be stated that it establishes conclusively, by unquestionable documentary evidence, backed up by the instruments themselves, the following most telling points:—

1st.—"*Reis's telephone was expressly intended to transmit speech*," was, in fact, invented and constructed to convey speech as such and all other sounds.

2nd.—"*Reis's telephone, in the hands of Reis and his contemporaries, did transmit speech.*"

3rd.—"*Reis's telephone will transmit speech.*"

These three points being so well and fully established, as in this work, it can no longer remain a possibility for an eminent knighted witness to be "surprised to hear that Reis's instrument ever spoke at all," or to treat Yeates's modification of it "as a good joke." And it is now manifest that Reis's instruments in 1865 will compare favourably with Bell's at the Centennial in 1876, which were then quite as imperfect, and yet were lauded as a great and wonderful discovery by Sir Wm. Thomson, who seems not to have appreciated the importance of the principles involved in Reis's, now found to underlie and include all that is good in the present commercial telephone, which Bell's inventions did not, whilst Edison's advance no new principle. Both these inventors, however, are worthy improvers of Reis's inven-

* By Silvanus P. Thompson. E. & E. N. Spon, 16, Charing Cross.

tions, following, but varying, his methods, and so bringing forward toward successful use, as was his hope, the invention which was the main work of his life.

Another Inquirer.

[We expect our correspondent, "Das Telephon," is well aware that Ferguson's work was brought forward in the Edinburgh trial, and he expressed surprise only that it was not alluded to in the case which was tried before Mr. Justice Fry, in May, 1882.—EDS. ELEC. REV.]

"Will Atlantic Traffic Support Two New Cables?"

In your footnote to my letter of the 27th ult., contained in your No. 306, dated the 6th inst., you quote a paragraph from your article upon the above question, which you give as your opinion as to what would result "if a shilling rate were introduced."

Your conclusions are based upon a gross revenue of £607,640 to be produced by the 1s. rate, $\frac{2}{10}$ths of which —£122,000—you allocate to the new company; then comes the paragraph to which I have alluded—

"The two new cables would, therefore, during a shilling rate, receive about 5 per cent. for their money, and have 3 per cent to carry to the reserve fund."

Now 5 per cent. upon a capital of £1,200,000, is	£60,000
and 3 per cent. to reserve, is	36,000
equal to ...	£96,000

which deducted from £122,000, leaves £26,000 to pay the working expenses, paid out and all other charges, a sum not half enough to work two cables.

You appear to have forgotten working expenses altogether, and to have distributed a 5 per cent. dividend before providing for them, which seems to me to be "putting the cart before the horse."

H. Weaver.
Managing Director.

Anglo American Telegraph Company, Limited,
26, Old Broad Street, London, E.C.,
8th Oct., 1883.

[We regret that when we responded to Mr. Weaver's last letter we misapprehended what that gentleman desired to point out. From the above communication, however, we perceive that he draws our attention, not to our not having answered the question, but to the way in which we answered it in our leader of the 22nd ult. As a matter of fact the working expenses were not forgotten, as Mr. Weaver says, but we will take our figures in a less favourable way, and even then it will appear that a 1s. rate will allow of 5 per cent. upon a capital of £1,200,000, and something will yet remain for the renewal fund.

Gross traffic at 1s. per word	£607,640
Less working expenses	222,100
	£385,540
New cables will take $\frac{2}{10}$ths of £385,540 =	£77,108
Now, 5 per cent. on capital of £1,200,000 (the estimated cost of the new cables)	60,000
Leaving for renewal fund	£17,108

Or about 1½ per cent.

We have gone so far out of courtesy to Mr. Weaver, but the point of our argument will remain the same whichever way it is put, viz., that a low tariff must be much more disadvantageous to the older companies than to the newer one.—EDS. ELEC. REV.]

Lightning Conductors.

Since you have almost invited a reply to Colonel Parnell's criticism of the "lightning rod," which you reprinted from *The Newcastle Chronicle* in your issue of the 29th September, may I be permitted to take up a little space in your valuable journal?

Having compiled "nearly 700 detailed records of lightning accidents, including 124 instances of failure of lightning conductors," Colonel Parnell has arrived at the extraordinary decision that "these instruments are mostly contrivances for inviting lightning to buildings." I say extraordinary decision because it seems to me that the idea of "inviting lightning" is a peculiarly happy one, and when we are told later on that "by all admitted electro-static laws" a lightning conductor simply does this by acting as an accumulator of electricity, one is naturally inclined to ask, by which electro-static law or laws is this proven? If a conductor be electrically connected to earth one might for ever attempt to charge that conductor with electricity without any result whatever. Even provided that a lightning conductor was insulated, or had "bad earth," which is unfortunately in many cases true, it cannot come under the definition of an electro-static accumulator.

If, instead of forming absurd theories, Colonel Parnell would fall in with the generally-accepted views which have been based upon practical experience, he would find that in almost 99 cases out of every 100 where lightning conductors have been found inefficient the cause is due to one fault alone, viz., *bad earth*.

The case of an upward discharge, or a discharge from earth to clouds, on which Colonel Parnell lays great stress, is one of very rare occurrence, for although I have watched many thunderstorms in this and other countries I have only witnessed a single case. I think we may take it that in most cases the clouds are positively electrified and the earth negatively electrified. True there are cases in which some of the clouds are negatively electrified, but discharges then take place chiefly with other clouds which are positively electrified, and which happen to be in the same vicinity.

A lightning conductor in good order is just as efficient in protecting property against a discharge from earth to clouds as it is in protecting it against a discharge from clouds to earth. In each case it is the path of *least resistance*. I must therefore differ entirely with Colonel Parnell on this point. Before leaving it, however, I must remind him that he has committed a flagrant injustice on the memory of the late Prof. Clerk Maxwell when he says "that he distinctly announced his agreement with the above-mentioned views," meaning that he—the professor—entirely agreed with Colonel Parnell's views in regarding a lightning-rod as an accumulator. The idea is monstrous. Let us turn to page 50, vol. 1, of "Maxwell's Electricity and Magnetism," and we there read his description of an *electro-static* accumulator. It is as follows:—"A system consisting of two conductors, whose opposed surfaces are separated from each other by a thin stratum of an insulating material, is called an electric accumulator." Does a lightning conductor answer to this description? If Prof. Clerk Maxwell ever used the term "electric tap" at all, he evidently meant it in quite the reverse sense to that which Colonel Parnell would have us believe. A lightning conductor is provided with points for precisely the same purpose as the collector of a frictional electric machine is provided with points, and whether the discharge be upwards or downwards these points serve the double purpose of facilitating the collection or dispersion of electricity.

I will pass over Colonel Parnell's suggestion, "Why not exert our efforts *solely* to tap and disperse in the most economical manner this deadly thunder-bolt, electricity, which accumulates under our feet?" with advising him to communicate with a certain *accumulator* man, whose invention was the object of some ridicule in the ELECTRICAL REVIEW some time since. The two might work together and form a company to "disperse this deadly thunder-bolt, electricity," and supply the same "in the most economical manner" for the many purposes to which electricity can be applied. It is fortunate that *electricians* of the Parnell class are rare.

This ludicrous suggestion, however, leads on to the distinct assertion that "there is hardly an 'electrician' in this country who believes that the action of lightning is other than that of a sort of stream of 'electric fluid' descending from the clouds (where they hold it is generated) to the earth." This indeed is news. We

may see lightning, or the luminous effects of atmospheric electricity, but we cannot and never shall see *electricity*, much less "a sort of stream of 'electric fluid.'" Surely the days of one fluid and two fluid theories have long since passed away. With the beautiful atomic and molecular theories which modern chemistry has indelibly impressed on our minds, with the recent revelations in heat, light, and sound, shall we still call electricity a *fluid?* Fluid is matter, and matter may be defined as that which we can handle, weigh, analyse, and which the mind can form a definite conception of. Chemistry alone would tell us that electricity cannot be a *fluid*.

Electricity, whether in a static or dynamic state, is generally regarded as a *force* acting upon the molecules of matter in a manner peculiar to itself, but categorical with such forces as heat, light, and sound, in accordance with the principles of the transformation of energy. I do not say that electricity produces an undulatory motion of the molecules of its conducting media, or whether it simply produces a rigid molecular strain or polarisation, but one thing, I believe, is admitted, viz., that the higher the *electromotive force* the greater is the tension or molecular strain in the conducting media. Electricity then, whether static or dynamic, is one and the same *force*, static electricity being simply a quiescent accumulation of electricity of very high tension. And, now that I have come to this part of the subject, I should like, with your permission, to describe to your readers an experiment which might be as novel to some of them as it was to me, and which I tried some four or five years ago when experimenting in telephony. This consisted in charging a short telephone line on *metallic circuit*, and well insulated from earth, by means of a plate electrical machine. The weather being favourable, it was possible to charge the line to such an extent that neither of the call-bells at either end could be rung by the batteries, and it would be some minutes before this could be done, and then the bells would only ring very feebly, but would gradually get louder and louder. I tried this experiment with the view of ascertaining what effect atmospheric electricity had on telephone and telegraph lines. Had this line been connected to earth it would of course have been impossible to have charged it with electricity; but there is this conclusion to be arrived at, viz., that all the vast number of telephone and telegraph lines which employ earth as return are really a *protection against lightning*, while those employing a separate wire as return, or what is called *metallic circuit*, are really the reverse.

With regard to Colonel Parnell's explanation of the occurrence at Dinnington Colliery, I venture again to disagree with him in that the metal guide ropes, &c., had acted in any way as *accumulators*. They simply acted as conductors; and in my opinion the discharge was not from earth but from the clouds.

Great stress is laid upon such words as "lightning explosion" and "thunder-bolt." We all know that lightning assumes different forms, but the luminous phenomena of atmospheric electricity are governed by the same laws and are subject to the same conditions as the luminous phenomena of high-tension currents with which we are familiar. Sheet lightning, for example, which takes place in rarified air, is precisely the analogue of the *electric glow* which we can produce on a small scale in rarified air from a conductor having a sharp point, or by means of discharges in rarified gases in the beautiful Geissler tubes. We have also atmospheric discharges similar to the *electric brush* and which are generally accompanied by sound. Then there is the chain or forked lightning, which we can compare to the *disruptive discharge* we are familiar with, and which usually takes place in dense air, and, last of all, there is the *electric spark* itself, spherical in appearance, and which is analogous to *globular lightning*, or what Colonel Parnell calls the "thunder-bolt." In all cases *the character of the discharge depends entirely upon the nature of the charge and the characters of the media through which the electrical convection takes place, and also upon the character of the surface from which the convective discharge takes place.*

One thing, however, must be acknowledged and that is—whatever Colonel Parnell or anyone else may say—the good service which lightning conductors having *good earth* have already done, whatever has been the nature of the discharge. He has, unfortunately, said one thing which is only too true, "that the number of private individuals" in this country who employ lightning conductors is practically infinitesimal. It would be greatly to our advantage if we took a lesson from that wonderful country the United States, where the lightning rod was first used, in this respect. In that country, where thunder-storms are very much more severe than here, it is a very common thing to find comparatively small houses with no less than *four or five* lightning conductors to each house, and the damage to property is much less than in Great Britain. In many country places these conductors are made of iron, which is, of course, by no means so efficient as copper; but if they can't afford copper they have iron, so alive are they to the importance of protecting property from lightning.

The criticisms of men like Colonel Parnell do a great deal of harm, because there is always a class of people who believe everything they see in the newspaper. There is one way, and one way alone, of protecting our property from lightning, and that is by having good lightning conductors, not too thin and cheap, but with plenty of sectional area in them, if I may be allowed to use the expression, for this is really the important point, and also by having these conductors periodically tested in order to see that they make *good earth*. Mr. Anderson has already done good work in his advocacy of these points. I do not happen to possess his book, which was favourably reviewed in the ELECTRICAL REVIEW some two or three years ago, as this is a subject which I have studied little, indeed it is almost out of the domain of electrical engineering, but, no doubt, he will come forward in the cause of the lightning conductor, and take up "the cudgels" in a far more able manner than

Charles Lever.

Bowdon, Cheshire,
Oct. 5th, 1883.

The extraordinary letter of Col. Parnell, originally appearing in the *Newcastle Chronicle*, finds a prominent position in your pages for Sept. 29, and in your footnote you invite opinions thereon. Perhaps it may not be out of place to suggest the insertion of two letters which appeared in the paper referred to later on—viz., August 30th, and the latter may, perhaps (when printed in your journal) evoke some reply from Col. Parnell. I am glad to find a matter of so much importance taken up by you, thereby introducing the subject to those who, perhaps, will deal with the matter as it deserves.

Samuel Vyle.

[EXTRACT.]

A recent, and what might be called standard authority, is "The Lightning-Rod Conference," whose report was issued in 1882, and to which is attached the signatures of some dozen Fellows of the Royal Society. On page 3 of the report they say "there is no authentic case on record where a lightning conductor, properly fixed, has ever failed to do its duty." The volume referred to, however, abounds with instances of conductors neglected—*i.e.*, those that have been tested or examined, until after some calamity, to know their condition above ground, or earth connection below, and it is most strongly urged that periodical tests be made, and pointed out that where such precautions are taken the buildings are, in spite of sneers to the contrary, "protected" from damage by lightning. One of the gentlemen on the conference referred to, Mr. W. H. Preece, F.R.S., Electrician-in-Chief to Her Majesty's Postal Telegraphs—than whom no man has devoted more time to conductors, or read more papers thereon, especially prior to the telephonic era—and whose evidence is strongly in favour of increasing the number of conductors now in use. His theory that the space protected by each conductor is a radius whose base is equal to the height of the conductor, is very generally accepted as being within a safety line.

In addition to this, we have the evidence of Colonel Parnell's gallant comrade, Major Bucknill, R.E., who, after having tested a large number of lightning conductors on powder magazines, &c.,

for which he was specially detailed by the War Office authorities, and advocated a greater use of conductors, insisting upon records being kept of the tests made from time to time. Indeed, so much stress did he lay upon the value of testing, that he devised and registered a new form of Wheatstone Bridge, for the special purpose of quick and accurate testing.

In the face of the facts and evidences that we have of the value of lightning conductors, *as they are plus careful erection and subsequent examination and testing*, we want further evidence of the value of Colonel Parnell's new theories before adopting them; and as one interested in the efficiency of lightning conductors, I have read the gallant gentleman's work, without, however, being very clear or greatly enlightened as to his substitute. It rests with him to make its value known, and, furthermore, to add a word or two as to cost.

SAML. VYLE.

[EXTRACT.]

The writer (Colonel Parnell) informs us that he has compiled "nearly 700 detailed records of lightning accidents, including 124 instances of the failure of lightning conductors." It might have conduced more to the satisfaction of the reader, and the value of the statement, if some reason had been assigned for the 124 failures. Only a few weeks ago, a tall chimney at the works of Messrs. Moss & Gamble, Wadsley Bridge, near Sheffield, was struck by lightning, and the lightning conductor was shattered to pieces. Upon examination, I found that the conductor was an old corrugated tube one, with defective joints, and it was just at these joints where the explosions and consequent shattering took place.

Perhaps the "Colonel" might have added this case to his list of "124 cases of failure," but manifestly it would have no scientific weight whatever in determining the value of a conductor, any more than a hole in the water-spouting round a roof would argue in favour of the abolition of such spouting. Another case that came under my personal observation two or three days ago at Sheffield may possibly throw some little light upon the question, and help to show how the failure of lightning conductors are brought about. I was invited to examine a conductor on a gentleman's residence, and I found that it was broken off some three or four feet from the ground, and consequently had no connection with the earth at all. Had that residence been struck by lightning, the case would have been cited as another instance of the failure of lightning conductors. But would it have been fair to do so? Surely not.

I could double the "Colonel's" 124 cases in a very short time, and when I had done so, I should only have proved that the failure was not due to the "conductor," properly speaking, but to the unskilful method of erection, or a violation in some way of the principle of electrical science.

Speaking of conductors as a source of danger, the "Colonel" says:—"I have the less diffidence in trying to impress your readers with this unquestionable fact—with this lesson, that nature manifests with unerring precision in all countries and at all times, inasmuch as the same idea is already deeply rooted in the minds of a proportion of quite 999 persons in 1,000 in the United Kingdom."

I think it is generally admitted in intellectual circles that the value of scientific evidence is largely measured by the manner in which it is offered, and that broad statements, unsupported by actual fact, do not argue very well for the wisdom or reliable knowledge of the person who makes them. To quote again—"Very few educated persons, besides professed 'lightning conductor' advocates and 'electricians,' *i.e.*, persons interested in the manufacture or in the manipulation of electrical instruments, will say a good word for lightning rods; and (apart from manufacturers) the number of private individuals in this country who employ these contrivances is infinitesimal."

Really I cannot understand in what part of the country the "Colonel" has been living. The number of lightning conductors is daily increasing. and thousands are being annually erected on private houses which do not belong to "manufacturers."

If "very few educated persons will say a good word for conductors," and "the number of private individuals who employ these contrivances is infinitesimal," and it is admitted by the "Colonel" that "manufacturers" do employ these contrivances, then he cannot mean anything else but that manufacturers do *not* belong to the "very few educated persons." Of course, a "Colonel" could not be guilty of any discourtesy, but among the inferior quality of persons known as "electricians" such a statement proceeding from their number would be regarded as a lamentable breach of good taste, and a pronounced assumption of conceit. To say the least of it, the "Colonel" is not happy in the arrangement of his sentences.

After paying a slight tribute to the value of the "point" of the conductor, the writer makes another rash and unqualified assertion:—"There is hardly an electrician in this country (let it be understood that I am using this term in contradistinction to that of physicist) who believe that the action of lightning is other than that of a sort of stream of 'electric fluid' descending from the clouds (where they hold that it is generated) to the earth. . . . . They allow in a casual manner that the rod's point *may* do good, but they look on its function as entirely secondary."

It speaks little for his reliability, and less for his wisdom, to make any such absurd and self-evidently false assertion. The "Colonel" refers to the case of Armley Gaol, which was struck by lightning on the 12th July; and he says:—"I may mention that the great central tower of Leeds Prison (much higher than the turret) is fitted with a lightning rod; and this rod was quite unsuccessful in the *role* that 'electricians' would have allotted to it."

Now it so happens that I visited Armley Gaol a day or two after the accident alluded to, and, upon inquiry, I was informed that originally the prison was provided with lightning conductors, but that some time ago an official came down from London and ordered all the conductors, with the exception of the one on the central tower. to be pulled down, as they were not only useless, but positively dangerous.

What follows? Well, the result was the accident of the 12th July. "But," says the "Colonel," "the conductor should have protected the whole building." Indeed! Does the "Colonel" know anything about meteorology and the disposition and density of clouds? If so, he should know why a conductor on one high elevation does not necessarily protect the whole surrounding neighbourhood.

The utility of the lightning conductor is too well established, its protective properties are too well known, to admit of its being blown away by the breath of a theorist.

W. T. HAWKINS.

The late Richard Werdermann.

I am sorry to read in your last issue that your kind effort in collecting help for the widow and family of Mr. Werdermann has not, thus far, met with that encouraging response from his scientific brethren you naturally looked for.

Our esteemed friend, like many other workers in the attractive paths and bye-ways of technical science, was unhappily too much engrossed in its exacting pursuits to allow him sufficient opportunity for the promotion of his own material interests; the fate of many distinguished scientists, and one that claims our earnest practical sympathy. Of all classes in this moving life there can be none more sensible than Mr. Werdermann's brethren of appeals, such as the one in question, especially to those whose better fortunes in scientific pursuits protect them from the unhappy results that have befallen Mr. Werdermann's worthy family. Here is a just tribute to his memory from the *Lumière Electrique*:—

"We record with the greatest regret the death of Mr. Richard Werdermann, the well-known electrician, to whom we owe the first idea of the employment of parallel carbons as an electric candle.

"The incandescence lamp bearing his name, and exhibited at the International Exhibition of Electricity at Paris, was chosen for the saloon of the President of the Republic, and lighted equally, with a steadiness and remarkable brightness, the entrance vestibule, drawing room, and the theatre in all its details. Richard Werdermann, who was one of the first to recognise the value of the Gramme machine, and to introduce it into England, was the inventor of several dynamo-electric machines.

"His scientific labours in the field of electricity were moreover of the most varied nature. He was not merely an eminent electrician, but was a very distinguished chemist, and united to a large practical sense a yet more philosophic mind."

W. M.

Electrical Railways.

I read in you edition of the 6th inst., a note at foot of my letter in which you ask, "Who is Orestas?" I must plead guilty to a slight error which occurred through my clerk's want of knowledge when taking down the letter from my dictation. Nevertheless, I feel almost sure that you, and certainly the majority of your readers, knew the name should have read "Œrsted," the Danish philosopher, the same who made the first substantial discovery of the magnetic force of the Voltaic apparatus. As to Watt, which I find printed with a final "s", I do not know whether this is my error or that of your printers, but this is of no consequence, for when we consider what an important part steam plays in generating electricity, you must not cry "How comes Paul amongst the Philistines?" but let such a name pass as "more appropriate" than "Judge", unless, as I have since been thinking, that the latter title may be as a sly hint that there will be required at least one "Judge" to settle the patent rights of the electrical world.

H. Binko.